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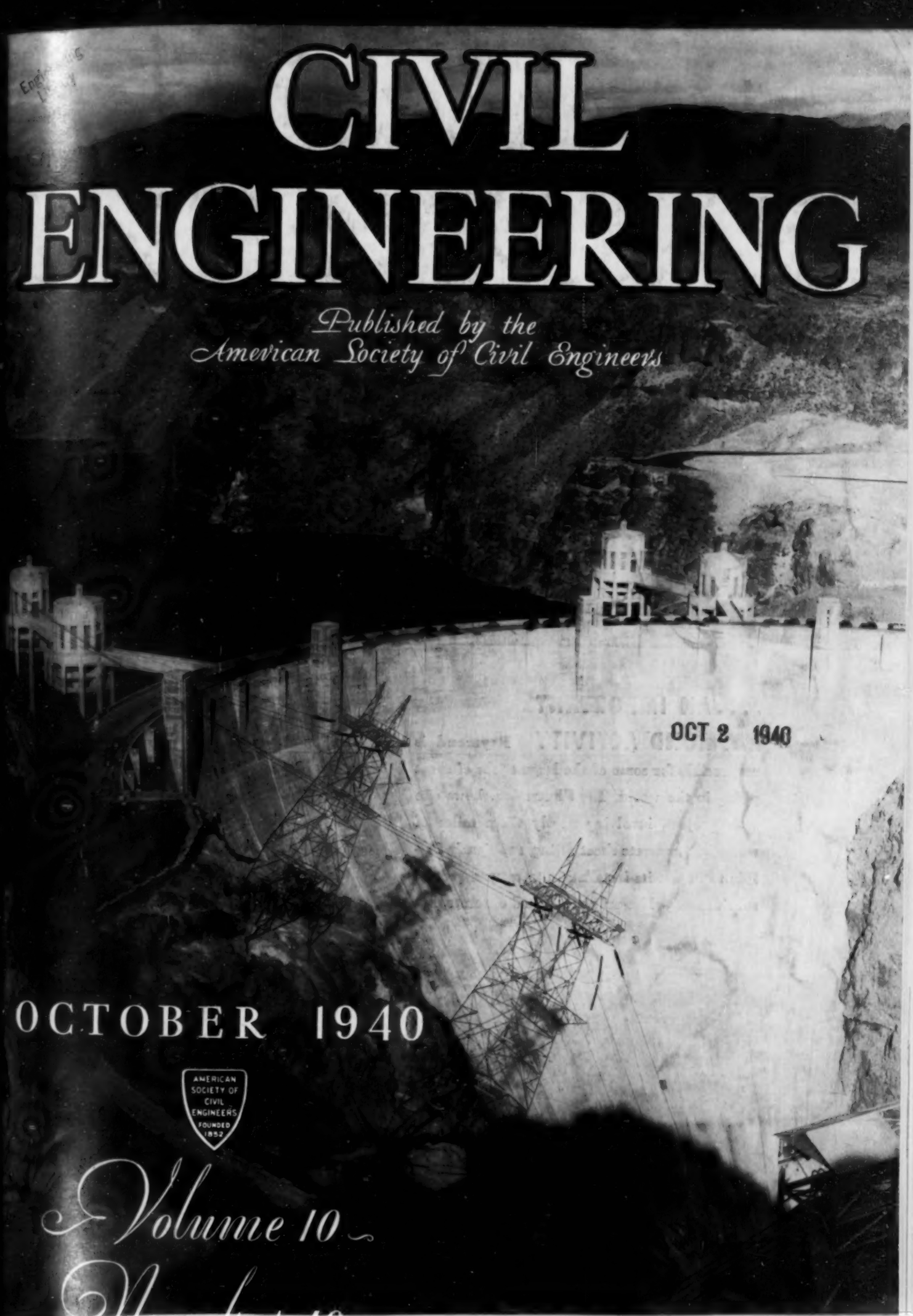

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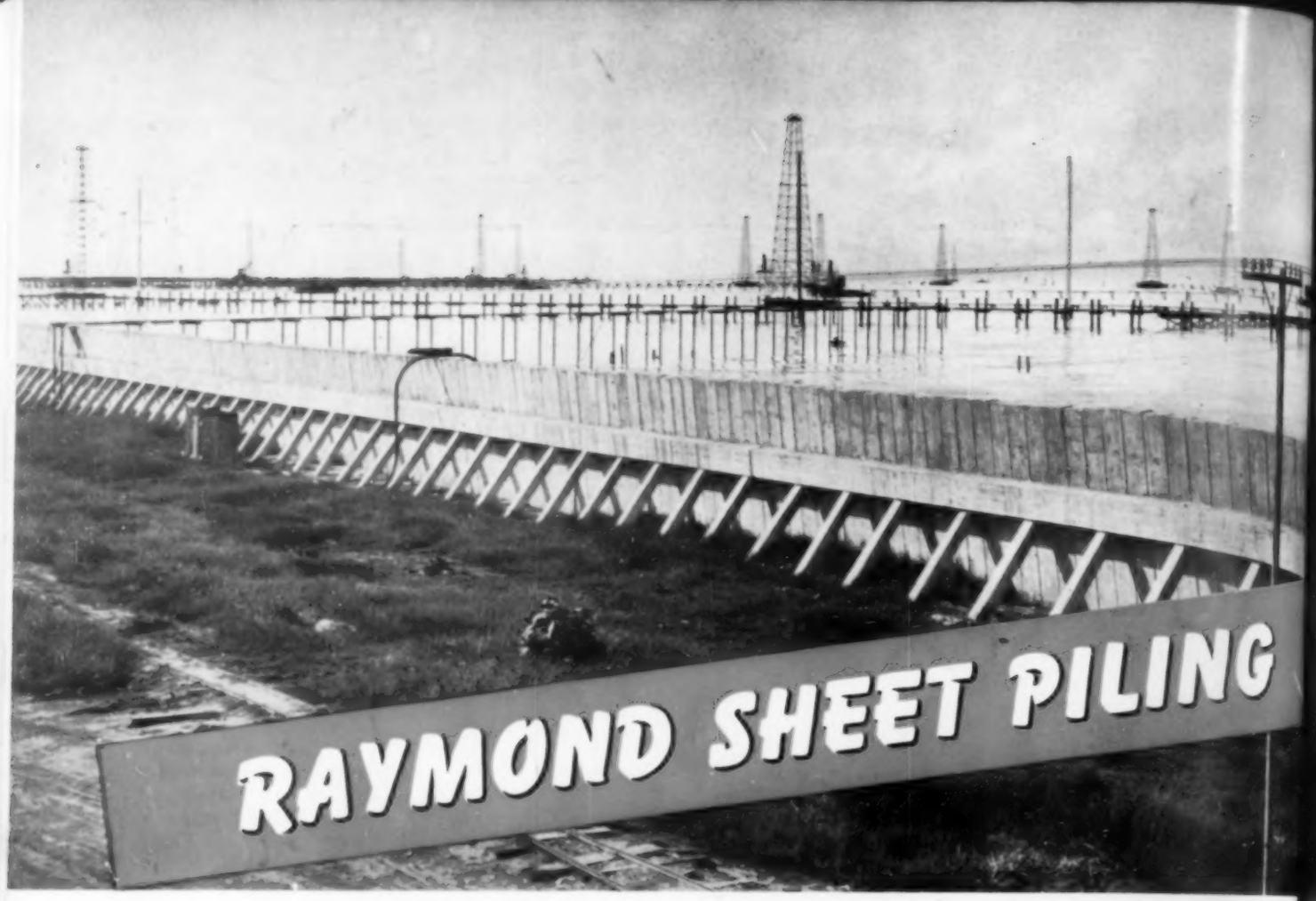

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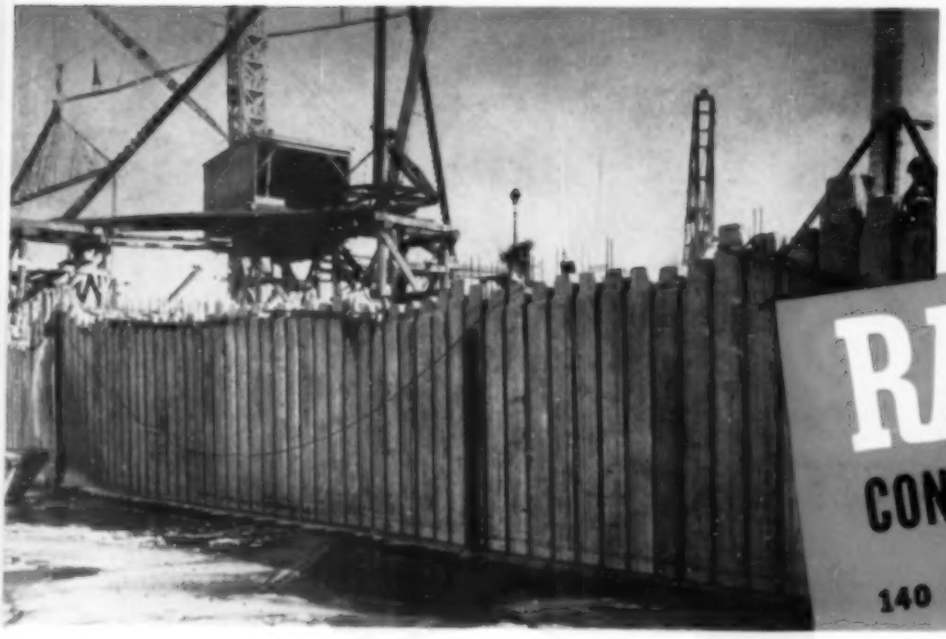

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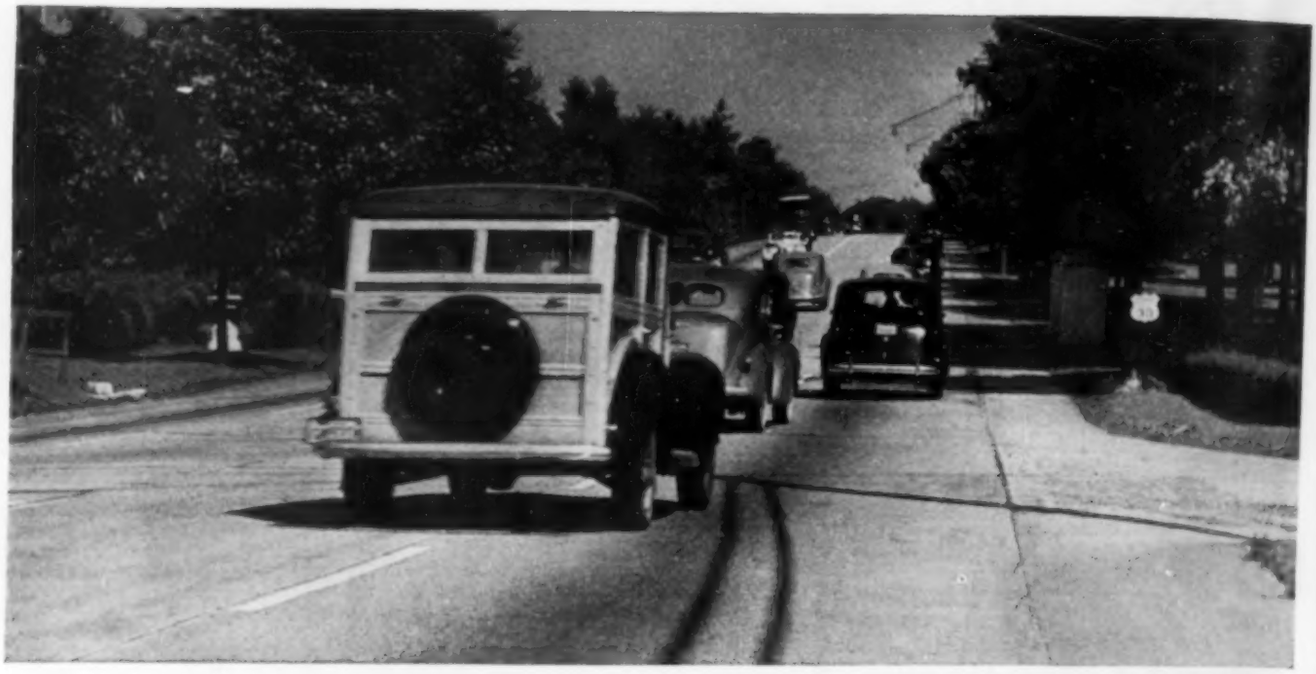
'INCOR' QUALITY PAYS ON
LINCOLN HIGHWAY



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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Engineer and Labor

Abridged from a Paper Presented Before the Third Annual Engineers' Night Banquet of the Technical Staff of the Aluminum Company of America at New Kensington, Pa., April 2, 1940

By E. A. Holbrook

Dean, Schools of Engineering and Mines, University of Pittsburgh, Pittsburgh, Pa.

In human society, "labor" is no more a problem than are our professional groups of engineers and physicians. Labor cannot be solved like a problem in geometry. Labor and engineering are each continuing relationships, with changing emphasis—not problems which we can solve and then put out of our minds.

Of the many statements defining labor, capital, and organization or engineering, none has ever been so clear and vivid to me as the truism generally credited to Andrew Carnegie, "Industry is a three-legged stool, whose legs are capital, business (organization or management), and labor." Certainly only when we can keep these legs of the same general length is the stool comfortable. At times in the past hundred years we have seen the capital leg too long, and at times technical progress in the management leg has made an uncomfortable seat for America. I am not so sure but that today we need to examine carefully the labor leg.

How Technologic Change Affects Labor.~Inventions, technologic applications of labor-saving devices, and the development of new useful products have made us the first great nation to be comfortably fed, housed, and clothed. But with other advances we have experienced the danger of technologic unemployment.

Analyzing this phase of the problem, Emil Lederer finds that following a new technical development, either wages must be temporarily reduced in order to make such technical improvements less advantageous, and therefore to retard them; or production must be increased sufficiently to restore the workers to employment. Temporary reduction of wages may be the only way out for labor and industry to keep up the cycle of (1) hiring workers, (2) increasing wages, (3) bringing in technologic improvements, (4) putting men out of work, (5) lowering prices, (6) increasing production, (1) reabsorbing or hiring workers, (2) and so on.

It appears that the sooner we realize these basic truths, the sooner will we ease the shock of job-losing through technologic progress. The more union labor freezes wages at an irreducible level, the slower the reabsorption of labor following an intensive invention, and the more difficult the engineering and management part of the problem.

How Labor Affects Technologic Changes.~Labor unions have been able to gain and hold members only by proving to them that it is wholly due to the union that their wages have been increased. Unions must always be getting more and more for their members, else they fail. What labor and the public do not understand, however, is that the steady wage increases that have occurred in the past fifty years would have been utterly impossible had it not been for the efforts of the technologists.

Labor's increased demand has been a straight-line curve angling upwards, while the engineer's effort has been a curved line, moving sharply upwards at first, but as the easier technical innovations were accomplished, becoming flatter. Technical economy, which really made possible the increased wages of the union worker, now is unable to keep up its end of the race. The profit has been taken out of capital, and if labor is to demand its ever-increasing wage rate, technology and management cannot provide the wherewithal—bankruptcy must come. Then, if the industry is essential, either the state or the worker must take over the industry and run it for their own benefit, if and when it is a benefit.

Reduced to its simplest terms, what I have said means that the unions appear better satisfied to have 1,000 of their men work for $10 a day than to have 2,000 work for, say, $7 a day. I doubt if this is always good public policy. I am sure that under this policy we, as technologists and cost reducers, are not going to be able to do our part in keeping the economic stool comfortable.

Industrial Engineering and Labor.~What of the effect of technologic methods that have to do with management, with ways of getting things done, with the functions exercised by every foreman, boss, and executive? Military organization, the straight-line rule from top to bottom, was perfected by the Roman Caesars. Leaving out the military discipline, this general plan of organization has not been outmoded in present industrial organization. Divided responsibility never has and never will work, whether in Soviet Russia or in a Pittsburgh barber

shop. The operating or management engineer's job is to keep responsibility undivided; to modify past rigors to suit the high intelligence and fair-play standards of present-day labor, and to keep labor informed of where and for what the company stands. Prominent labor leaders have agreed that order, discipline, and responsibility are functions of management. But they more and more claim the privilege of consultation by labor. To this there is no valid objection. However, if and when final decisions of industrial and business policies pass from capital and management to the worker, then our present industrial system will come to an end.

Most historians claim that our great industrial nation is based on the invention of the steam engine, the vulcanizing of rubber, the telephone, and other material things. To me as an engineer, our greatness lies as truly in the discovery and subsequent development, by engineers and management, of three great methods or techniques.

I. Interchangeable Parts and Standardization.—In 1818 Eli Whitney, known to every school boy for his cotton gin, was director of U. S. Arsenals. At Springfield, Mass., he worked out, for the first time, the jigs, gages, methods, and standards by which the same parts of rifles were each made exactly alike, and could be used interchangeably—a monumental development, truly, the full import of which was not realized for a hundred years.

II. The Taylor System of Scientific Management.—To many the Taylor System of Scientific Management is an instrument of the devil, used to extract the last ounce of energy and the final drop of sweat from the poor worker. The essence of the method is to do work in the most orderly manner, so that the worker and management alike may accomplish more and better work in less time with less effort, and under greatly improved working conditions. It is indeed scientific control of industry. Recently Philip Murray and Morris L. Cooke, in their book, *Organized Labor and Production*, stated that Taylor "took the chaos of his day and gave us orderly industry." Surely after such a tribute from enlightened organized labor, there can be no further discussion of the real value of the Taylor system in our industrial and social economy. In part the system involves time and motion studies, which have, at times, been abused by incompetent engineers or greedy management. This does not in the least change my belief that today, under modern unionized shop methods, labor realizes that its own, as well as management's interest, rests on the correct application of industrial engineering based on the Taylor system.

III. Assembly-Line Mass Production.—Perhaps future historians will remember Henry Ford as a great pioneer rather than as the maker of a particular automobile. Nowhere before had men the courage to manufacture great quantities of intricate standard machine parts, and to fit them into a marvelously complex machine such as the automobile by means of moving assembly lines. He made production so cheap that Mr. Common Man could afford what had been considered a luxury.

Not every engineer has the type of mind fitted to deal with management problems. Executive ability is a natural gift; nevertheless, for the industrial executive who likes to deal with methods and men, recognition of the principles evolved by Whitney, Taylor, and Ford must always be of first importance.

The Engineer and His Own Labor.—In our country today there are more than 300,000 engineering graduates, of whom 70% retain some dominant engineering interest. That is a lot of brains. However, the total non-duplicate membership of our great national technical engineering societies is hardly 60,000. What technical and professional voice have the vast non-affiliated majority?

It is my belief that the average mature engineering graduate is a specialist, an individualist, and a conservative. He is happiest when working with things. Increasingly he becomes a part of a large industrial organization or of some governmental service. For example, more than half the civil engineering graduates in the country of the past few years are in government services. One coal company which a few years ago had three technical graduates, now has 165 for about the same tonnage production.

Professionalism vs. Unionism.—Mr. Average Engineer has overwhelming power technically, but as a professional unit his voice has been inaudible. He is a member of the youngest of all the learned professions, in which most of the branches are not yet a lifetime old. As I stand on the sidelines, I see that he is individually a basic necessity in America. But in a day when great new forces are sweeping over us in industrial and economic confusion, he cannot, if he would, remain a solo performer.

Let us not be deceived, the labor idea is widespread and growing among many young engineering graduates. We can say that this is all wrong and that engineering is a profession and not a trade. Let me tell you, if older engineers cannot somehow make our great mass of younger graduates professionally minded, within fifteen years we may be largely trade union in pattern.

With us a civil engineer engaged in public work is often a registered professional engineer, but a mechanical engineer, a specialist in a corporation, often says, "Ho, Hum! I have nothing in common with that civil engineer; why should I take the trouble to become registered?" Certainly if he thinks only of himself there is no reason.

Earning Respect.—We engineers have a training or professional preparation period of ten years as against seven for the lawyer. Today, the engineering groups in our colleges have very high intelligence ratings. Our work is as varied, as creative, as daring, and as profound as is the lawyer's. But when I learn of what the Bar Association is attempting to do in raising professional standards, promoting ethical practices, and stopping fraudulent ones, I realize how far we have to go professionally in engineering. Most important of all, when a young lawyer is admitted to practice, he subscribes to a code of professional ethics and takes that beautiful oath of admission which ends, "I will never reject, from any consideration personal to myself, the cause of the defenseless or oppressed, or delay any man's cause for lucre or malice; so help me God!"

What a professional goal for us to aim for in engineering—to have a similar ritual and a known professional ideal ever before our young men! It would be a final answer for all time, proving that engineering is not a skilled trade but a profession, demanding the broadest and most exacting knowledge and the highest devotion to honesty. Truly "the laborer is worthy of his hire."

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VOLUME 10

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The Broad View of Reclamation

National Wealth Vastly Increased in Last Four Decades by Federal Irrigation Program

By JOHN C. PAGE
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
COMMISSIONER, BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, WASHINGTON, D.C.

AFTER 38 years of work under the federal Reclamation Act it is fitting to take stock of the progress that has been made in national reclamation. The primary purpose of this act was the establishment of farms and homes, and today the existence of some 70,000 irrigated farms and 258 towns on federal projects bears witness to the fact that this purpose is being realized. The social and economic bases of the program are here discussed by Commissioner Page, in a paper which was originally presented before the Society at its 1940 Annual Convention in Denver, Colo.

IRRIGATION of arid lands in the United States under the federal Reclamation Law is a double-barreled enterprise. It is a social program as well as a business proposition. It creates opportunities for the establishment of new homes and it develops the western states, which have been carved from the 700 million acres of arid and semi-arid lands within our national boundaries.

This combination social and physical development makes good common sense. Older nations have recognized that fact. Down through all recorded history, nations situated in dry climates have viewed irrigation as a responsibility of the state. The world's oldest civilizations grew in irrigated fields and after thousands of years they are still flourishing in the irrigated valleys of Egypt, Syria, Persia, and India.

On this continent before the time of Columbus, the Indians were irrigating fields of corn in the Southwest. The Spanish missionaries brought with them to the southwestern deserts from the lands bordering the Mediterranean a knowledge of irrigation methods and practices which they planted in American soil.

The Anglo-Saxon stock which dominated in the early settlement of the Atlantic seaboard and which participated in the expansion westward, had no experience in arid climates. Nevertheless, when it came into the arid and semi-arid lands west of the 100th meridian, it quickly adapted itself to the new conditions, as evidenced by the introduction of irrigation by the Mormons in Utah in 1847. The Mormon settlements could not have been supported on the shores of Great Salt Lake except by irrigation.

It is regrettable that there was no irrigation lore among the people who founded the United States. The common law of England, recognizing riparian rights, hardly was appropriate in arid and semi-arid climates. The founders of the new nation which declared its independence in 1776, fighting a war in the humid, verdant valleys east of the Allegheny Mountains to make that declaration stick, never foresaw that the United States would cover a vast arid domain far larger than the area of the 13 original colonies.

Because of these facts the United States was slow in assuming its national responsibility in connection with irrigating and developing its arid lands. Initial successes and final failures of other methods of settlement and development of these lands had, therefore, to precede federal action. Even today, 38 years after reclamation was adopted as a national policy, there is a general lack

OWYHEE DAM, 417 FT HIGH, COMPLETED IN 1932, WAS AT THAT TIME THE HIGHEST DAM IN THE WORLD
One of 93 Storage Dams Built or Building by Bureau of Reclamation

A CITY WHOSE ECONOMY RESTS ON IRRIGATION
Boise, Idaho, as Seen from Union Pacific Depot

of understanding in the populous, humid areas, where settlements are older, of the conditions and problems that make irrigation necessary in the West, and a lack of appreciation of the objectives and achievements of the federal reclamation program.

It is true that the United States could have become a great nation without irrigation, for two-thirds of its territory is humid. But it never would have become as great a nation as it is today without the 20,000,000 acres of irrigated land in the western states. The economic destinies of more than 13,000,000 people in this arid region, and great cities, such as Los Angeles, Phoenix, Salt Lake City, and Denver, rest upon farming by irrigation and the industrial growth made possible by conservation of water. Our irrigation projects are the piers on which the transcontinental railroads bridge the deserts of the West.

The story of this western development parallels the evolution of irrigation in the United States. After the Mormons diverted the waters of City Creek, and before the federal Reclamation Act was passed, simple and easy water diversions were made from hundreds of creeks and rivers in the West. By 1900, eight million acres were irrigated as the result of individual, corporate, cooperative, and state enterprise and a population of four million was being supported in this western third of our country.

FEDERAL RECLAMATION ACT PASSED IN 1902

By 1902 most of the easy diversion had been completed. Most of the remaining opportunities for developments required construction of storage dams, costly canals, and other works with which the federal government alone could cope. On June 17, 1902, the federal Reclamation Act became law, marking the culmination of more than half a century of experimentation—half a century during which private financing of intricate irrigation developments was proving wholly inadequate, half a century which saw half-measures tried.

The entry of the federal government into the field stimulated other investments as well. There was a rapid expansion of irrigation, only a part of which is the direct result of federal activities. Large areas were watered by pumping from underground sources, particularly in California. Irrigation projects already in existence were expanded. Some entirely new projects using surface waters were developed by irrigation districts. For the last 15 years, however, the federal government has been virtually the only agency engaged in irrigation development.

In less than four decades, the Bureau of Reclamation has placed works in operation to serve nearly 4,000,000 acres of land. Of this total approximately 2,500,000 acres were once unproductive desert, and 1,500,000 acres were in non-federal irrigation districts which had inadequate water supplies. Today the Bureau has a great construction program, the largest in its history, which will provide water to about 2,500,000 additional acres, transforming them from sagebrush wastes into productive farms that will support a million people. This will bring up to 5,000,000 acres the total of new lands the Bureau has watered.

Equally as important as the irrigation of new lands is the provision of supplemental water for areas already irrigated. Water tables lowered by overdrafts on underground supplies, unanticipated droughts, and inadequate storage facilities threaten many areas with desolation or stagnation. Stabilizaton of these communities is vital to the public welfare. Rehabilitation projects, therefore, make up about half our present program. They will serve 3,500,000 acres, including a great area in the pumping section of central California. They will bring to almost 5,000,000 acres the lands that will have been rescued by the federal government.

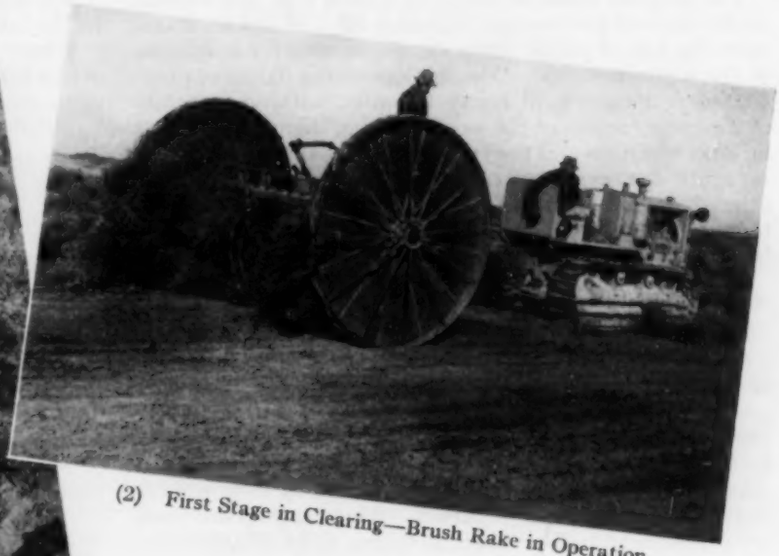
LOOKING TOWARD THE FUTURE

Many of the developments that will be made in the future will require engineering works of great size and complexity, and most of them will be on interstate streams or on the main stems of large rivers. The Bureau of Reclamation estimates that perhaps as much as 20,000,000 acres additional can be irrigated with water resources as yet undeveloped and under policies now in effect. The future growth of the West will be correlated in large measure with the conservation of these remaining water resources and their beneficial use.

In the future, as in the past, the Bureau will build sound structures. Reclamation projects are considered permanent national assets, and so durability must be an objective of project construction.

AN OUTSTANDING EXAMPLE OF PRODUCERS' COOPERATIVE IN BOISE VALLEY
Dairymen's Cooperative Creamery at Caldwell, Idaho

(1) Coyote's Range Land—Sagebrush



(2) First Stage in Clearing—Brush Rake in Operation

(3) The First Irrigated Crop

LAND ON THE PAYETTE DIVISION, BOISE PROJECT, IN THREE STAGES OF DEVELOPMENT

DITCHER CONSTRUCTED FROM OLD ROAD GRADER BUILDING LATERALS NEAR HOMEDALE, IDAHO

SETTLERS LEVELING NEW LAND FOR IRRIGATION IN SUCCOR CREEK DIVISION, OWYHEE PROJECT

The original basis on which irrigation was undertaken by the federal government was that 90% of the revenues from the sale of public lands should be used for irrigation in the western states. The settlers on the irrigated projects were required to repay the cost, without interest, of the construction of the works serving them. The public land revenues and the repayments by the settlers were set aside as a revolving reclamation fund. This was considered a good business proposition on the part of the federal government, and in my opinion it has proved to be exactly that.

FACTS AND FIGURES TO SHOW THAT RECLAMATION PAYS

Reclamation projects completed and now operating as a result of this policy have repaid more than $62,000,000 of the cost of the works serving them. They support more than 1,000,000 people on some 70,000 farms and in some 258 project towns. They produce more than $100,000,000 of new wealth annually. They have produced more than $2^1/_2$ billions of dollars of new wealth since they first started operation. They have created and are protecting taxable values in excess of $4,500,000,000. They provide an annual market for produce and manufactures of the humid areas worth more than our foreign trade with many countries that are considered prime markets for American goods.

Let me repeat these facts. They are worth repetition—homes and a chance for a good livelihood for a quarter of a million American families; a crop production valued at $100,000,000 a year; a market for American industry worth $200,000,000 a year; taxable property carved out of lonely desert totaling more than $4,500,000,000. This is what reclamation has brought to the country.

From the first, however, Congress has looked on the federal reclamation program as a social program also. It directed that settlement be on family-size farms. It has written into the law from time to time provisions to prevent speculation in project lands and to protect the settlers. It directs that in selling surplus power from project plants preference shall be given to publicly owned or cooperative distributors. It declared this year "that, in the opening of entry of newly irrigated public lands, preference shall be given to families who have no other means of earning a livelihood, or who have been compelled to abandon, through no fault of their own, other farms in the United States, and with respect to whom there is a probability that such families will be able to earn a livelihood on such irrigated land."

The present practices and methods of the Bureau of Reclamation, even the present method of financing construction and the development of the large multiple-purpose project, are also the products of evolutionary processes.

The Reclamation Act of June 17, 1902, was brief. It contained only a few hundred words. Subsequent legislation making up the body of the federal Reclamation Law, however, together with interpretations, makes a volume of several hundred closely printed pages. There have been no startling innovations, however, in this body of law. The original principles—economic feasibility and reimbursability—still govern. For the most part, only logical extensions have been made as changing conditions have dictated.

When the sales of public lands diminished and virtually ceased, other revenues, such as a portion of the royalties from oil and minerals taken from the public lands, were added to the Reclamation Fund. When it was found that reservoirs being constructed to serve federal project lands could also be made to provide supplemental water to projects already in existence, provisions were made by which water could be supplied under adequate contracts to the latter areas also.

When, with the construction of large dams, it became evident that such structures could provide for power generation, a measure of flood protection, and aid to navigation, as well as irrigation storage requirements,

COMMUNITIES THAT HAVE GROWN UP IN RECLAIMED AREAS PROVIDE SCHOOLS AND PLAYGROUNDS FOR YOUNG AMERICANS

constructive steps were taken to authorize planning for these multiple and related functions.

It obviously is appropriate that the federal government should insure a wide distribution of the benefits of these works built in the public interest. These advances were made step by step to that end.

In recent years, beginning with the institution of the first major public works program, the reclamation fund has been supplemented and augmented by allotments and appropriations from other sources. Construction financed by the reclamation fund has cost $265,000,000. In addition, allotments from emergency funds totaling $190,937,000 have been made and $324,540,000 has been appropriated from the general treasury. The allotments from the emergency funds for reclamation projects are also reimbursable, and about 25% of the total expenditure is chargeable to power and will be returned with interest at a rate of not less than 3%. Projects like Boulder Dam, Grand Coulee Dam, and the Central Valley Project in California, never could have been financed wholly from the reclamation fund. I consider each of these, however, wholly justified in the public interest, and it is appropriate that general funds have been made available for their construction.

RECLAMATION POLICY RESTS ON A SOUND BASIS

President Theodore Roosevelt told Congress in 1901, "It is as right for the national government to make the streams and rivers of the arid region useful by engineering works for water storage as to make useful the rivers and harbors of the humid regions by engineering works of another kind."

This view cannot be questioned. Historic as is the policy of river and harbor improvement for navigation however, I do not mean to imply that the justification of federal reclamation rests wholly on this comparison. The work of conservation and utilization of the precious water resources of the West stands firmly on its own feet.

While other peoples make terrible wars for expansion we have only to build great works to provide ourselves with elbow room. This constructive endeavor, which will more than pay its own way through direct returns to the common treasury and increases in taxable wealth, pays dividends in future security as well. I see in these great water projects and the developments that go with them, ramparts which will guard our civilization and which may serve it as well as the canals built more than 4,000 years ago have served Egypt.

How Old Are Our Cities?

A Rational Approach to Estimates of Population Growth

By C. J. VELZ, ASSOC. M. AM. SOC. C.E.

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and HENRY F. EICH

SENIOR (1940) MANHATTAN COLLEGE; RESEARCH FELLOW IN SANITARY ENGINEERING, VIRGINIA POLYTECHNIC INSTITUTE, BLACKSBURG, VA.

WITH all signs pointing to a leveling off of population in the not-far-distant future, increasingly careful attention must be given to the estimation of population change. As a basis for their own predictions, the authors of this paper first reconstructed Verhulst's theory of limited human increase to make it apply to a technological society, and devised a straight-line plotting of the Pearl-Reed logistic curve to simplify the data analysis. Two measures of growth characteristics—"present age" and "coefficient of growth"—were then developed, and determined for all United States cities having a population of 25,000 and over in 1930. Finally, from these data, the "saturation values" and the 1940 populations were predicted. First test of their methods, therefore, awaits only the publication of the returns from the 1940 Census. Only "sample data" are published here; the complete tables have been placed on file in the Engineering Societies Library in New York, N.Y.

IN the brief period of 164 years between 1776 and 1940, the United States has grown from 2½ million to about 133 million. During this interval population in Europe grew from 150 to 500 million and the entire human family increased from ½ billion to 2 billion. While the human race and Europe quadrupled, the United States multiplied fifty-fold. In the long span of human history nothing approaching these rates of increase has ever occurred, and probably nothing like it will ever occur again.

Prior to this period, for as many hundred years as anthropologists can piece together, world population remained almost constant, fluctuating with changes in environment slightly above or below the mean equilibrium to which, apparently, man was permanently adjusted (Fig. 1). Then, in the eighteenth and nineteenth centuries, coincident with the development of inanimate power and the application of science and sanitation, population suddenly jumped far beyond its usual variation. A continuation at these rates would lead to ridiculous numbers. Unmistakably, the end of this fantastic era is approaching. Today every index points to a leveling off, and unquestionably stabilization of population will be reestablished.

In the United States the political, social, and economic pattern has been shaped on the basis of a continuously expanding society. After these years of phenomenal growth, it is difficult to think in other terms and to comprehend the future on the basis of a stabilized society. The ease with which the transition from the steep upward slopes of the past to the horizontal of the future will be made depends upon our ability to foresee and evaluate the change. To the engineer in a highly urbanized, technological society this change is of more than academic interest; it is of practical importance in his daily work in the control of man's environment. Every engineering endeavor ultimately goes back to a problem of population change: manufacture and distribution of commodities, transportation, communication, power, water supply, sewage treatment, housing, recreation—all are projected on the basis of population. Errors in prediction and excessive investments in facilities which, during the period of rapid expansion, were soon absorbed by the momentum of growth, may stand out, in a period of stabilized society, as catastrophic mistakes. Consequently, it becomes increasingly important to the engineer to measure and evaluate more carefully the characteristics of population change.

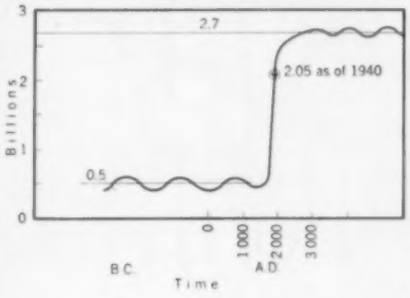


FIG. 1. POPULATION OF THE WORLD

With the acceptance of the thesis of a limited increase as the basis for human growth, questions immediately arise concerning the nature of the growth of specific human colonies, and since a technological society is primarily an urban society, it may be asked, How old are our cities? What is their limit, their life span? What is their stage of development, and at what rate are they approaching their limit? Is each colony a law unto itself, or are there marked common characteristics? The answer to these and similar questions involves more than merely a consideration of the number of individuals. It is concerned with the characteristics of the city as a unit, the potentialities of the colony as a whole.

Before analyzing the population pattern of American cities it is necessary to introduce the measures employed in this study. The mathematical development and the detailed technique, however, are omitted because of space limitations.

The fundamental basis for the measurement of growth of population employed in this study is: If population is expanding freely in a society of unlimited economic opportunity, the rate of increase is constant. If it is growing in an area of limited economic opportunity, the rate of increase must tend to get less and less as the population grows, so that the rate of increase is some function of the population itself, limited to a saturation value by the level of economic opportunity. This basis is essentially Verhulst's theory of limited human increase applied to a technological rather than an agrarian society. In a complex technological order economic opportunity is a more important determinant of population saturation than land area, and the authors have reconstructed Verhulst's theory accordingly.

Mathematical expression of Verhulst's thesis is best exemplified in the classical work of Pearl and Reed, as their logistic or S curve. Variations in this basic form will be from the steep, with sharp transitions, to the flat, with easy, gradual changes (Fig. 2.)

In order to simplify the work of application and extend the usefulness of the logistic curve, the authors have converted it to a straight-line form and developed a corresponding logistic

population grid from which the essential measures have been developed.

The limit of human increase is population saturation. If this limit is arbitrarily fixed at 100%, population values will be expressed in terms of percentage of population saturation value. This changes the concept from numbers of individual human beings to the much more valuable consideration of the age of the entire unit or colony, expressed as a percentage of its ultimate limit. Furthermore, on this basis all colonies are directly comparable, irrespective of the number of individuals within each. If observed data converted to percentages of saturation are plotted on the logistic grid they will approach a straight line. If growth is logistic they will plot exactly as a straight line, and if not strictly logistic the variation from a straight line is an indication of the skew from true logistic form. Furthermore, in the slope of this line lies the answer to the rate of maturity and the life span of the community.

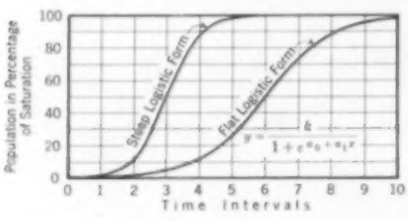


FIG. 2. PEARL-REED LOGISTIC CURVE

The rate of maturity and the life span of a logistic growth are measured by the over-all pitch of the logistic curve rather than by the slope of the curve at any point or through any particular decade, a slowly maturing community describing easy, flat S curves and a rapidly maturing community describing sharp, steep S curves (Fig. 2). It is apparent, therefore, since the logistic grid reduces the S curve to a straight-line form, that the true over-all rate of growth is readily measured as the slope of the straight line of the data plotted on logistic paper. The authors have termed this slope the "coefficient of growth." In addition to defining life span, this new measure is an invaluable aid in the comparative study of the pattern of growth among communities.

The application of the technique of population analysis that has just been set forth is predicated upon a determination of population saturation value. No one simple method for predicting the saturation value of population is available. Precise mathematical techniques may be employed but are no more reliable than the assumptions upon which they are based; there is no substitute for judgment. The ultimate limit to growth is determined by economic opportunity, the measure of the ability of the individual to maintain life and a standard of living conducive to procreation. In estimating the ultimate limits of population from historical record, the "sport" of the nineteenth century should serve as a check against overconfidence in statistical methods. With this in mind the most probable limits, however, will be indicated in the recorded trends. According to the fundamental thesis propounded, as the rate of increase appoaches zero the population approaches its limit—saturation. This limit is approximated if ratios of increments of increase for intervals of time to population are plotted against population at the ends of the periods. In most cases this plotting approaches a straight line and the population intercept at the zero rate of increase determines the saturation value within reasonably narrow limits.

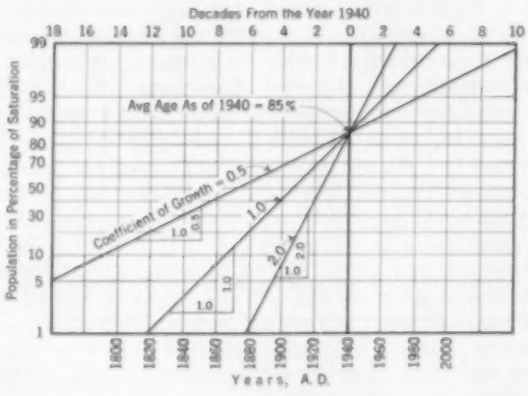


FIG. 3. LIFE SPAN AND TIME FROM 1940 TO POPULATION STABILIZATION OF AMERICAN CITIES OVER 25,000

With the population measures thus defined, let us proceed to apply them to the cities of the United States and attempt to answer in more specific terms the questions here raised. The authors have analyzed over two hundred communities throughout the United States, the first group of which pertains to large centers of population, 100,000 and over, designated in the 1930 census as "metropolitan districts." In order to obtain a true representation of growth of these large centers, the population of contiguous outlying areas, as well as that enclosed by the political boundary of the major central city, has been included. In large centers there is a tendency toward decentralization to the peripheral ring reflecting abnormal growth in suburban areas and subnormal rates or actual declines of resident population in central portions. Obviously, the growth characteristics of the district are reflected in the combined population of the entire colony as a unit. The second group deals with smaller cities from 25,000 to 100,000 population, definitely outside of metropolitan districts—that is, small centers of population each of which is a colony in itself rather than a segment of a larger district. In this group of communities the population of the central city was used without adjustment and it must be recognized that certain of these cities, in turn, have contiguous outlying areas which may be of sufficient magnitude to influence the true unit growth. The studies are based upon U.S. Census records and were made prior to the 1940 enumeration. Two measures—coefficient of growth, and age of community as of 1940, expressed in percentage of saturation—have been computed for cities in each class. Space prohibits publishing the complete tabulation, but typical results are shown in Tables I and II.

From these results, what can be ascertained concerning the age of our cities? On the basis of medium saturation level, the mean age of 75 metropolitan districts as of 1940 is computed to be 83.5% of saturation. In other words, America's large cities are well beyond the prime of middle age and are pressing hard on to old age, with only $16\frac{1}{2}\%$ to go to their saturation levels. Furthermore, there is remarkable uniformity in age among the districts, the standard deviation from the mean being 7.2%. The most probable age of any district, therefore, is within $83.5\% \pm 4.9\%$.

What of the smaller cities outside of the metropolitan districts? Are they younger, older, or the same age as the large districts? Analysis strongly points to the generalization that the age of American cities is independent of the size of the community. As of 1940, the mean age of 100 cities throughout the United States of 25,000 to 100,000 population, is 86.2%, with a standard deviation from the mean of 7.8%. The most probable age of any small city outside a metropolitan district, therefore, will be within $86.2\% \pm 5.2\%$.

The computed difference between the mean age of metropolitan districts and of small cities (86.2%–83.5%) is only 2.7%. In view of the variation of the data this apparent difference is not real as measured in statistical terms. Since three times the standard deviation of the difference between the means ($3 \times 1.15\%$) is greater

TABLE I. GROWTH CHARACTERISTICS OF METROPOLITAN DISTRICTS OF THE UNITED STATES

Significance of Column Headings: (1) Metropolitan District; (2) 1930 Census Population (Millions); (3) Saturation Value (Millions); (4) Estimated Maturity 1940 in % Saturation; (5) Coefficient of Growth, *C*

(1)	(2)	High* (3)	(4)	(5)	Low* (3)	(4)	(5)	Medium* (3)	(4)	(5)
Atlanta	0.37	0.60	76	1.19	0.45	89	1.39	0.50	83	1.29
Baltimore	0.95	1.5	71	0.65	1.1	89	1.1	1.3	77	0.71
Boston	2.31	3.0	85	1.0	2.5	96	1.7	2.7	91	1.3
Buffalo–Niagara	0.82	1.25	76	0.98	1.0	87	1.10	1.1	82	1.04
Chicago	4.36	6.2	82	1.27	5.2	91	1.41	5.7	87	1.34
Cleveland	1.20	2.0	73	1.12	1.5	88	1.37	1.7	81	1.22
Denver	0.33	0.40	91	1.37	0.36	96.5	1.73	0.38	94	1.65
Kansas City, Kans. and Mo.	0.61	0.9	80	1.19	0.70	92.5	1.50	0.80	86	1.35
Los Angeles	2.32	4.0	77	2.2	3.0	91	2.5	3.5	85	2.4
Milwaukee	0.74	1.2	74	1.04	0.90	85	1.18	1.0	82	1.12
Minneapolis–St. Paul	0.83	1.3	76	0.97	0.90	96	1.75	1.0	91	1.31
New York	10.90	18.0	67	0.82	14.0	80	1.05	16	75	0.90
Philadelphia	2.85	4.5	71	0.72	3.5	86	0.92	4.0	78	0.78
Pittsburgh	1.95	3.0	80	1.17	2.3	92	1.39	2.6	84	1.16
St. Louis	1.29	2.0	75	0.84	1.4	92	1.13	1.6	86	1.0

*High—High saturation value, combination of factors favorable to growth; low—low saturation value, combination of factors unfavorable to growth; and medium—medium saturation value, most probable growth conditions.

than the computed difference, it can be said with practical certainty that there is no significant difference between the ages of the two classes of cities. Accordingly, from the combined data, the most probable mean age as of 1940 of any city over 25,000 population is 85% ± 5%.

Three important factors stand out from this study of the ages of our cities:

1. Remarkable uniformity of age or stage of maturity among the communities.
2. Absence of stratification in age with size or geographical location, there being no significant difference between large metropolitan districts and the smaller cities outside such districts.
3. Definite completion of the period of vigorous growth, with the attainment of the present average age for all cities of 85% of population saturation.

Perhaps more important than the stage of maturity of the American city is its rate of growth or life span, for it is this index which is the measure of the remaining potentialities of increase. Since we are at the contracting end of a great transition, the rate at which our cities round off to their saturation levels is of vital importance. In this the coefficient of growth, as previously defined, is the best guide.

With the probable error of the age of a community at ±5%, for practical purposes it can be assumed that the life span is the time interval in years from 5% to 95% of saturation. On this basis, a community with a coefficient of growth of unity would have a life span of approximately 11 decades (113.6 years). With the present average age of 85% of saturation, it would complete its cycle and enter upon a phase of stabilized population in approximately two decades hence. A slowly maturing community with a coefficient of growth of 0.5 would have a life span of approximately 22 decades and would reach stabilization four decades hence. Similarly, a rapidly maturing community with a coefficient of growth of 2 would have a span of 5½ decades and would reach stabilization one decade hence (Fig. 3). The life span or the interval between any stages of growth in years is inversely proportional to the coefficient of growth.

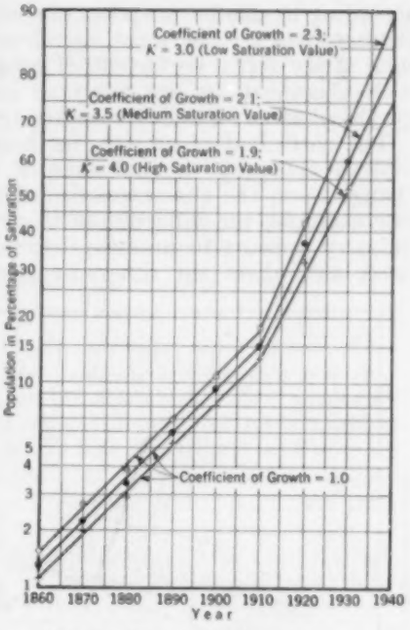

Coefficient of Growth = 2.3;
K = 3.0 (Low Saturation Value)
Coefficient of Growth = 2.1;
K = 3.5 (Medium Saturation Value)
Coefficient of Growth = 1.9;
K = 4.0 (High Saturation Value)
Coefficient of Growth = 1.0
Population in Percentage of Saturation
Year
1860 1870 1880 1890 1900 1910 1920 1930 1940

FIG. 5. DETROIT METROPOLITAN DISTRICT GROWTH

What then is revealed by an analysis of the coefficients of growth of American cities? Unlike their age, which is essentially uniform, their rate of growth as reflected by the coefficient of growth varies over a considerable range—0.5 to 3.5—and there appears to be a general progressive, geographical stratification interspersed with peak areas of high rates of growth. Consequently, a general average for all cities would misrepresent the true significance of the growth characteristics. A clearer appreciation of the pattern of growth is obtained from a study of coefficients of growth plotted geographically on a map of the United States (Fig. 4). By connecting points of equal coefficients, the authors have developed what they term isopropagal lines. These lines afford classification of areas by growth rates. The isopropagal lines show a general progressive increase in the growth rate from the eastern United States westward, with unusually high rates centering in mass-production industrial areas.

An analysis of coefficients of growth in accordance with size of community shows, as does the study of age, that growth characteristics are independent of the size of cities. In view of this lack of correlation, there appears to be no justification for classifying cities

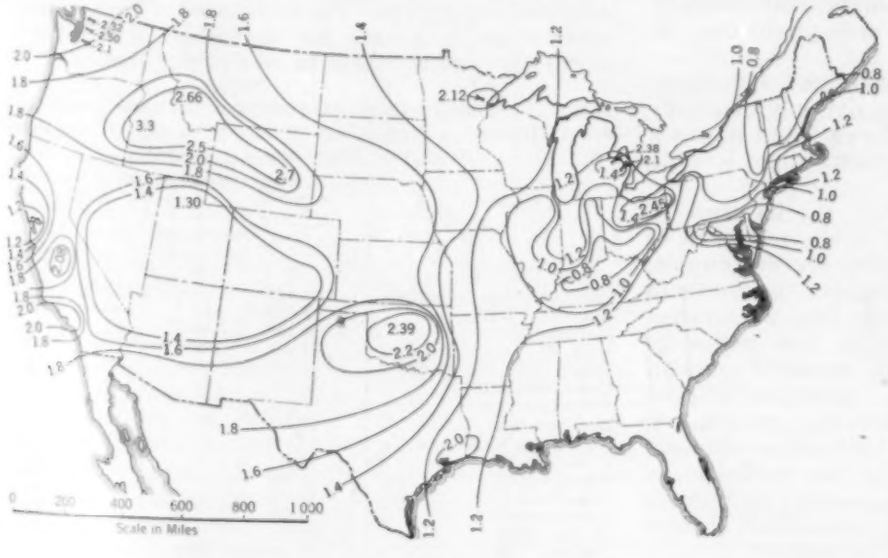


FIG. 4. ISOPROPAGAL MAP OF THE UNITED STATES
Coefficients of Growth for Cities Which Had 25,000 Population and Over in 1930

according to size for purposes of comparing their growth characteristics. The most significant classification for such study is by coefficient of growth, particularly if such classifications are analyzed on the basis of geographical areas outlined by isopropagal lines.

The coefficient of growth, furthermore, is a valuable tool in detecting the influence of economic or social change upon the characteristics of community growth. For example, the influence of modern mass-production industry appears to produce definite growth characteristics and alters the otherwise normal pattern. The

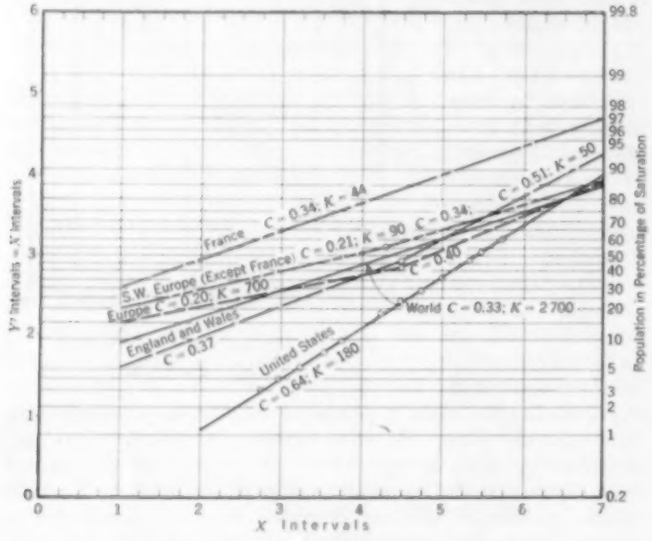

Y' Intervals = X' Intervals
X' Intervals
Population in Percentage of Saturation
France C = 0.34; K = 44
S.W. Europe (Except France) C = 0.21; K = 90
Europe C = 0.20; K = 700
England and Wales C = 0.37
United States C = 0.64; K = 180
C = 0.34;
C = 0.51; K = 50
C = 0.40
World C = 0.33; K = 2 700

FIG. 6. WORLD POPULATION; COMPARISON OF OTHER NATIONS WITH THE UNITED STATES
Plotting on Logistic Population Grid

Metropolitan District of Detroit (Fig. 5) prior to 1900 shows a clearly defined growth coefficient of 1, while after that date, and coincident with the introduction of the automobile industry, the coefficient rose sharply to over 2. Similarly, high coefficients are associated with other mass-production industries, and the two-stage characteristic is clearly apparent except in those instances where the birth of the community is coincident with the inception of the industry. Irrespective of geographical location or size of community, coefficients of growth of cities dominated by a mass-production industry cluster about the average of 2.3.

The high coefficient of growth associated with mass-production industrial areas indicates not only unusually high rates of growth during "middle age" but also is a danger sign of a "short life" and a very rapid leveling off in "old age."

As with mass-production industry, the influence of sociological change also is reflected in the coefficient of growth, and two-stage characteristics are measurable. This phenomenon is apparent throughout the Southern states as a concomitant of the change from an agrarian to an industrial society. Unusually low first-stage growth rates are evidenced, and the second stage is already indicated in the 1930 census. Results of detailed analysis of the Southern states, however, are not presented in this study, as data of the 1940 enumeration are necessary to define more definitely the coefficient of growth of the second stage of development. Preliminary studies, however, indicate that the communities of these states will fit into the general national pattern.

Of interest is the influence of the trend from decentralized state government toward centralized national government on the population characteristics of the nation's capital. The coefficient of growth of the metropolitan district of Washington prior to 1910 is 0.7, while after 1910 it is 1.5, showing second-stage growth.

Turning from the cities of the United States, what of the population of the nation as a whole as compared with that of other countries and of the world? The human race as a whole is well beyond "middle age." It passed the mid-point of its maturity about 1875 and at present has reached 75% of its ultimate growth, which is estimated at 2.7 billion.

The growth is logistic in character, with a coefficient of 0.33. The graphs for European countries (Fig. 6) reveal two-stage growth, with a definite break about 1870. Prior to this date the rate of maturity as measured by the coefficient of growth was about one-half that of the more recent period. This characteristic is not apparent for the United States and the world as a whole and may be associated with the change from feudal to industrial society on the Continent. Europe is maturing slightly faster than the world as a whole, with France the slowest at $C = 0.34$, and England the fastest at $C = 0.51$. Although Europe as a whole is at present about as old as the world, France definitely is in "old age," at a saturation of 95%, and England is a little younger than France at a saturation of about 85%.

As for the United States as a whole, no longer can it be thought of as a "young" country. Although it passed its mid-point between 1900 and 1910, it has already reached a maturity about equal to that of the world in general (74% of saturation), and furthermore, with a coefficient of 0.64, is growing old twice as rapidly as the general world community.

In the expression of age as a percentage of population saturation, and of coefficient of growth as the over-all pitch of the logistic form, two important measures are available for more careful evaluation of population growth characteristics of communities. These measures should be particularly valuable in national, state, and local planning. Projections of future growth on the basis of the steep "middle-age" rates of the past few decades unquestionably would result in spending vast sums for facilities for which, most probably, no population will exist. Furthermore, such misplaced expenditures will be reflected in shortages of funds for new types of facilities and services that will be needed in the transition to a stabilized population. The importance of a careful population study as a basis for the design of facilities to meet future needs cannot be overemphasized.

TABLE II. GROWTH CHARACTERISTICS OF CITIES OF THE UNITED STATES HAVING A POPULATION OF 25,000 TO 100,000 AND BEING OUTSIDE OF METROPOLITAN DISTRICTS

CITY	1930 CENSUS	BASED ON MEDIUM SATURATION VALUE		
		Sat. Value Thousands	1940 % Sat.	Coef. of Growth
(1)	(2)	(3)	(4)	(5)
Fort Smith, Ark. (after 1880)	31,429	36	94	1.40
Bakersfield, Calif.	26,015	38	85	1.76
Danville, Ill.	36,765	45	91	1.28
Joliet, Ill.	42,993	49	92	1.03
Muncie, Ind.	46,548	62.5	85	1.26
Cedar Rapids, Iowa	56,097	80	80	1.09
Hutchinson, Kans.	27,085	35	91	1.70
Lexington, Ky.	45,736	61	82	0.80
Kalamazoo, Mich.	54,786	64	91	1.26
Nashua, N. H.	31,463	38	86	0.78
Kingston, N. Y.	28,088	30	96	0.85
Jamestown, N. Y.	45,155	55	90	1.22
Springfield, Ohio	68,743	80	90	1.10
Marion, Ohio	31,084	44	83	1.22
Newark, Ohio	30,596	40	85	0.89
Texarkana, Tex.	27,366	30	81	1.28
Ogden, Utah	40,272	54	85	1.25
Green Bay, Wis.	37,251	48	86	1.17

Core Control and Cutoff Construction at Kingsley Dam

By W. J. Turnbull, Assoc. M. Am. Soc. C.E.

Soils Engineer and Chief of Laboratory, The Central Nebraska Public Power and Irrigation District, Hastings, Nebr.

and Geo. N. Carter, M. Am. Soc. C.E.

Resident Engineer, The Central Nebraska Public Power and Irrigation District, Ogallala, Nebr.

One of the problems frequently encountered in constructing full hydraulic dams is the presence of too many fines in the main borrow pits. In some cases it has been necessary to waste a good percentage of these fines, at considerable expense, to keep the confines of the core within design limits. But it was the exact reverse of this problem that confronted the engineers at Kingsley Dam, where the main borrow pits contained only 30% of the fines needed for core construction. In the first of the following articles Mr. Turnbull describes the means employed to make up this deficiency. Another interesting feature of the work at Kingsley Dam was the construction of a concrete curtain wall in one abutment. As described by Mr. Carter in the second article, the work involved driving a 600-ft tunnel into the hillside and sloping it down time and again as successive lifts of the wall were poured, until a curtain 100 ft high had been completed.

Both these papers were secured for "Civil Engineering" through the cooperation of the Nebraska Local Section.

Core Control in Hydraulic Sluicing Operations

By W. J. Turnbull

THE Kingsley Dam is a hydraulic-fill structure being built as an on-river dam across the North Platte River valley about 8 miles northeast of Ogallala, Nebr. Its purpose is the storing of flood waters to be used in a power and irrigation development in south-central Nebraska, between Hastings and Elwood. The main structure of the dam (Fig. 1) is about two miles long, and the dike adjoining it on the north is about half that length. In the main section the base width is 1,140 ft and the height 160 ft. About 20,000,000 cu yd of the 26,600,000 total yardage of the dam are now in place, and of this quantity at least 11% is core material.

The two main borrow pits, which furnish all the shell material and a part of the core material, are located in the valley, one upstream from the dam and the other downstream. Each pit is approximately 1,000 ft wide and extends parallel with the dam completely across the valley. The available material in the greater portion of the pits extends below the maximum feasible pumping depth of 45 ft.

The general geology of the dam site shows that the Brule formation, a consolidated dense clayey silt, underlies the entire area, and is the foundation bedrock for the dam (Fig. 1). The Brule is hard and impervious and from the structural standpoint is a very satisfactory foundation on which to build. In the valley section the Brule is overlain with an alluvial sand-gravel material ranging in thickness from 10 ft at the toe of the south bluff to 120 ft on the north at the toe of the blow-sand bluff. The sand-gravel alluvium is covered (except in the river channel) with a layer of topsoil ranging from about 1 to 10 ft in thickness. This topsoil is a sandy loam or loess and is the source of the core material available in the main borrow pits. The division line between the topsoil and the sand-gravel is very distinct. There are no buried clay layers or lenses in the sand-gravel alluvium.

The water table in the valley is in general only a few feet below the ground surface.

Under the south or right abutment the Brule rises about 100 ft in elevation and is overlain with the Ogallala sandstone formation, which averages about 200 ft in thickness. It was laid down by the ancient river as a fine silt to coarse sand with more or less secondary cal-

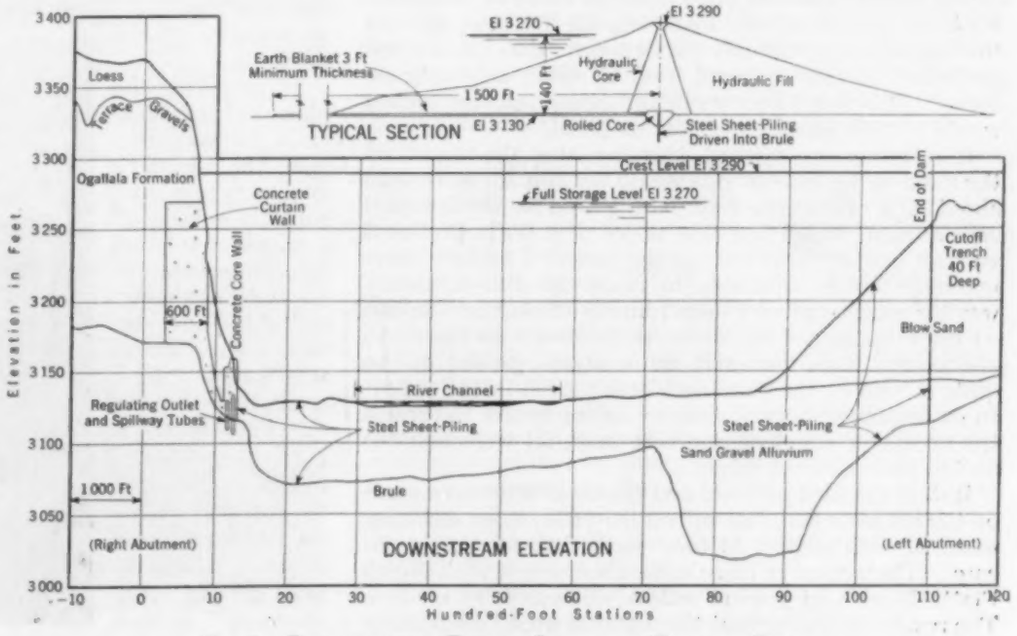


Fig. 1. Elevation and Typical Section of Kingsley Dam

GENERAL VIEW OF HYDRAULIC OPERATIONS
Pipe Line Floating on Core Pool Supplies "Make-Up Material," as Needed, from Auxiliary Borrow Pit

cium carbonate cementation. There are some alternating beds of semi-hard calcareous caliche sandstone, also a few beds of cemented conglomerate or "mortar" stone high up in the formation. Upon subsidence of the enormous flows of ancient times the valley was degraded and the new shore line was eroded and deeply incised at frequent intervals by side inflow of surface drainage, thus leaving the terrain adjacent to the valley as a series of ridges of which the right dam abutment is one. The Ogallala formation is overlain with a terrace gravel ranging up to 20 ft in thickness, and the latter in turn is overlain with a surface deposit of sandy and silty loess ranging up to 35 ft in thickness.

CHARACTER OF AVAILABLE MATERIAL

Initial study of the material available had showed that a hydraulic-fill dam would be the most feasible type of construction. The *Engineering News-Record* for July 13, 1933, page 26, gives gradation curves of borrow-pit material for 14 hydraulic-fill dams. The average gradation of the valley borrow-pit material (topsoil and sand-gravel combined) at the Kingsley site lay well on the coarse side of the average for those dams, thus indicating that a favorable shell material could be obtained. Further, a study of the loam and loess topsoil showed that its gradation was only a little coarser than the average gradation of core material from 27 other hydraulic-fill dams. This was a pretty safe indication that the topsoil would furnish satisfactory core material.

It early became evident, however, that the topsoil on the main valley borrow pits would not furnish more than about 30% of the core material required for the designed core section, which has side slopes of 1 horizontal to 3 vertical and is 110 ft wide at the base. The only other material readily available to make up the deficiency was the sandy and silty loess forming the surface deposit on the ridge extending to the southward from the south abutment. This material on analysis proved to be quite similar to the loam and loess topsoil in the valley. In consequence, borrow areas of sufficient size to furnish the necessary supplemental core material were laid out on this and adjacent ridges.

Rather detailed physical and chemical tests were made on the hill loess material and on the valley loam and loess material with respect to their suitability for use in the core. The action of these soils when mixed with North Platte River and ground waters was carefully studied. The results indicated that the material would consolidate very rapidly to a density which would furnish considerable stability to the core as well as render it quite impervious to the passage of water. Further, it appeared that very little if any tendency toward the formation of an unstable flocculence in the core pool would exist.

At the present time, some 2,100,000 cu yd of material have been placed in the core and there has been no indication of flocculation. Tests made with the 6-in. diameter iron ball, on core material placed not longer than 24 hours, show penetrations of only 6 in. to 2 ft. On some hydraulic-fill dams the penetration of the ball into the core material, a considerable time after placement, has been several feet. Undisturbed samples for weight tests taken from 10 to 20 ft below the surface of the core indicate that the rate of consolidation anticipated is being approximately obtained.

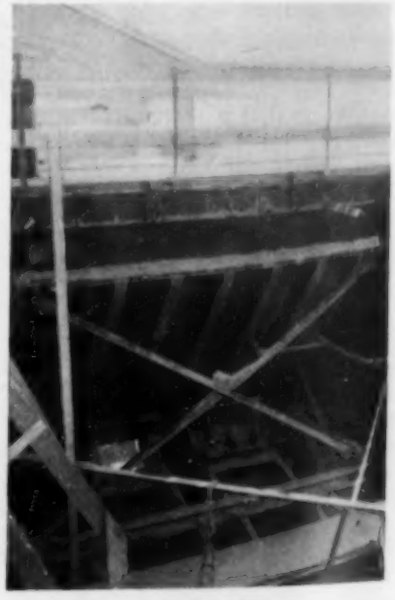
Table I shows the approximate average gradation of the various materials encountered in a cross section of the river valley on the axis of the dam, and will describe these materials more clearly than hundreds of words. Figure 2 (*a*) shows the average, maximum, and minimum gradations of the core and shell materials in the borrow pits, and Fig. 2 (*b*) shows similar curves for the materials as actually placed in the dam.

TABLE I. APPROXIMATE AVERAGE GRADATION OF MATERIALS ENCOUNTERED ALONG AXIS OF DAM

MATERIAL	% RETAINED ON SIEVE NO.						BUREAU OF SOILS CLASSIFICATION		
	4	10	20	50	100	200	% Clay	% Silt	% Sand
Sand-gravel (valley)	12	23	41	83	95	98	0	0	100
Terrace gravel (hill)	30	55	75	95	99	100	0	0	100
Loam and loess topsoil	0	0	3	8	19	50	8	25	67
Hill loess	0	0	2	4	11	42	6	31	63
Blow sand	0	0	0	12	65	99	0	1	99
Ogallala sandstone*	0	0	0	8	26	57	6	27	67
Brule	0	0	0	3	11	23	8	57	35

* The Ogallala sandstone contains from 2 to 50% of calcium carbonate.

In preparing the plans and specifications for construction, the District's engineers and consultants worked up a suggested method for placement of the hill loess material in the core section. This method was followed to a great extent by the contractor. A pump barge located in the south end of the core pool carries two 18-in. pumps, in series, driven by two 800-hp synchronous motors, which force water



THE HOG BOX

through a 20-in. pipe line to a steel hog box located on top of the south bluff, about 1,500 ft south of the top of the abutment and about 220 ft above the base of the dam. The hog box is 10 ft wide, 20 ft long, and 10 ft deep. Near its base, at one end, the incoming pipe line connects to a V-pipe arrangement that directs the water into the box in the form of two heavy jets under high pressure. Soil-and-water slurry is discharged out the other end of the hog box through an 18-in. pump driven by an 800-hp variable-speed motor. This pump is supplemented by another one of the same size mounted directly in the line several hundred feet distant. The slurry is directed to the core pool through a 20-in. pipe floating on the pool along the dam center line, and is dropped into the core through 6-in. by 9-in. trap openings in the bottom of the pipe. Each pipe section is 50 ft long, and has two trap openings that can be opened or closed as desired.

EXPECTATIONS ON HOG-BOX CAPACITY EXCEEDED

Core material is delivered dry to the hog box and dumped into a hopper with two openings at the bottom. A reciprocating shaker with sloping table is set below each opening. The material is fed onto the shaker and drops thence directly into the hog box, where it is thoroughly dispersed in the water by the two heavy jets. At the start of operations it was thought that, in order to secure a well-mixed slurry, the capacity of the hog box could not exceed 600 cu yd of material per hour. However, at the present time over 1,150 cu yd of core material per hour is being mixed. The increased capacity was obtained by cutting out one shaker entirely and dumping directly into the mixing chamber. During the period that only 600 cu yd per hour of core material was being mixed, the gravity head was great enough to force the core slurry material through the full length of the core line to the north end of the dam. However, when the production was increased to 1,150 cu yd per hour, the slurry became so heavy that it has been necessary to use the pump to keep the line from plugging.

The loess core material is dumped directly into the top of the hopper through a grizzly that is flush with the surrounding ground surface. The hauling equipment consists of three 24-yd wheeled scrapers pulled by crawler-type tractors and fifteen 13½-yd wheeled-tractor-and-truck units. The hog box is so located in the borrow areas that the longest haul is approximately one mile.

CORE-POOL PUMP FOR HANDLING "MAKE-UP" CORE MATERIAL

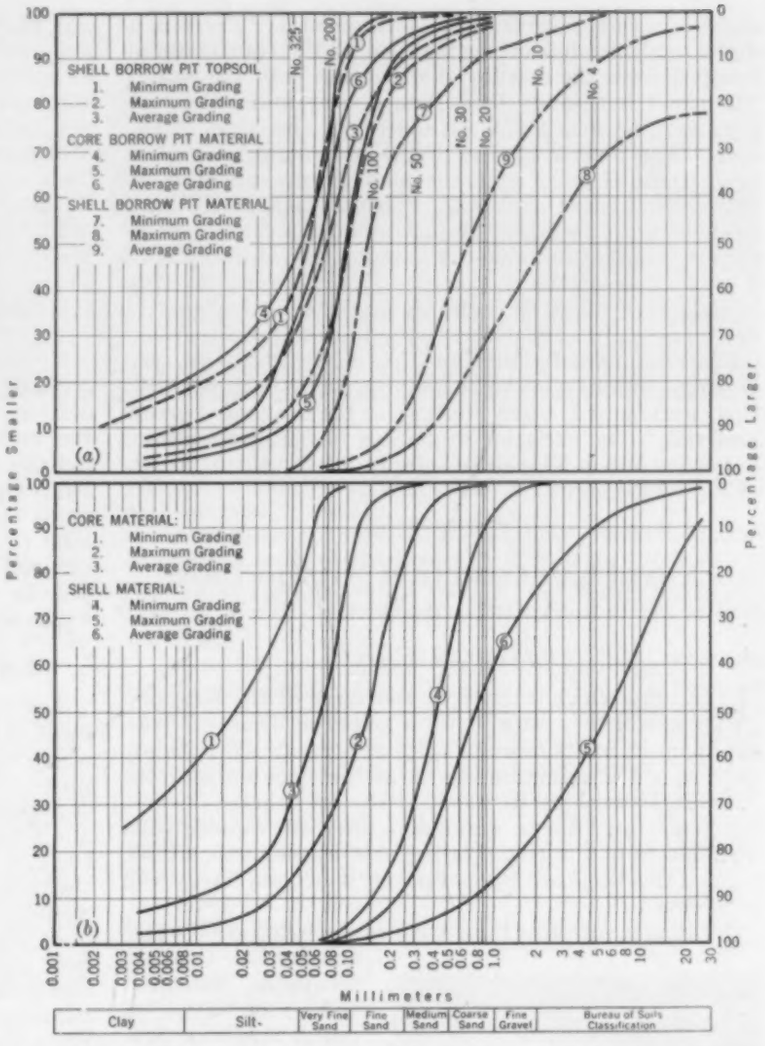


FIG. 2. PARTICLE-SIZE DISTRIBUTION CURVES FOR (*a*) BORROW MATERIALS AND (*b*) MATERIALS IN FILL, KINGSLEY DAM

For control of the dredging and core placement operations, frequent sampling in the core and transition-zone sections has been maintained. One sample is taken for about every 150 cu yd of core placed, and tested for particle-size gradation only. Later, record samples for density and moisture content as well as particle size are taken in the core and transition zones and in the shells.

CLOSE CORE CONTROL SECURED

It is believed that the hydraulic operations at the Kingsley Dam are unique with respect to the close control of the core as to quantity and rate of placement. The fact that about 70% of the core is placed by an operation completely independent of the two main dredges makes possible this close control. The quantity and rate of placement of the core material is based upon the findings of the routine field inspectors and the control sampling crews. Any tendency for either beach to encroach into the core, or vice versa, can be almost immediately arrested by changing the rate of deposition of the core material at the particular point or points in question. The physical evidence of the close control of the core is the fact that at present the average width of the transition zones is only about 40 ft.

The average depth of the core pool is maintained at about 4 ft. The under-water slope of the surface of the core from the core discharge line toward the transition

zones is about 1 vertical to 12 horizontal. There is a slight tendency toward segregation of the core material dropped from the floating pontoon line into the water. The result is a sandy loess immediately under the core line, merging into a fine silt loess near the edges of the core. The reverse is true of the core material washed in over the beaches from the main borrow-pit dredges. The general effect of this segregation is not detrimental to the core as a whole. It does produce a core in which the clay content of individual samples ranges from about 3 to 30%, as against a corresponding range of 3 to 17% in clay content of the core material as encountered in the borrow pits, and thus a wider variation in the consolidation characteristics of the core. However, the average consolidation of the core as a whole agrees with that anticipated from studies of the original borrow material. The variation in grading of the core material in borrow and in fill is shown graphically by a comparison of Figs. 2 (*a*) and 2 (*b*).

Novel Construction Method for Curtain Wall

By GEO. N. CARTER

THE ridge which is the right abutment of the Kingsley Dam will be subject to a reservoir head of from about 90 ft, at its base, to zero, at a point 100 ft below the top. The minimum width of the ridge varies from 1,300 ft at the base to 800 ft at the full storage level of the reservoir. These dimensions increase rapidly with distance from the river, as the side washes which have formed this ridge are comparatively short and have steep gradients.

Minimum safe length of path of percolation of water through the Ogallala formation indicated that some type of cutoff should be provided for a distance of 600 ft from the end of the core of the dam. Beyond that point decreased reservoir head and increased width of ridge combine to provide a safe condition with respect to seepage around the end of the dam.

LOOKING DOWN THE SOUTH ABUTMENT
Water Supply Line on the Right; Core Slurry Line on the Left

The Brule surface (Fig. 1), rising in a series of benches from the thalweg of the North Platte River valley, increases in elevation from a low of 3,015 to El. 3,170 (U.S.G.S. datum) where it levels out at a point within 200 ft of the end of the dam's crest, thereafter extending approximately level for several miles. Crest level of the dam is 3,290 and full reservoir level, 3,270.

Whatever cutoff might be constructed would obviously be founded on the Brule, and thus would be 100 ft high. First study was given to use of a compacted-fill earth core placed in an open cut. Such a cut would have been some 190 ft deep, and assuming the steepest side slopes to which it could have been safely excavated, it would still have been of such size that the ridge would of necessity have been almost entirely removed at the top. Moreover, some 700,000 yd of excavation would have been required, much of which would have had to be replaced as the rolled core was built up.

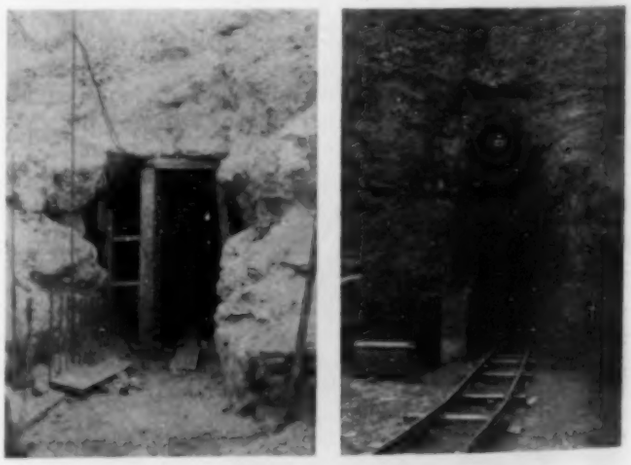
The Ogallala formation is too hard in some strata to permit of driving steel sheet piling, and some excavation obviously would have first been necessary had the formation offered any promise of admitting piling of the length required to reach the impervious Brule.

Consideration was next given to the possibility of grouting the abutment, and several tests were made to determine the feasibility of this method of sealing off the various sand and other pervious strata. Results indicated that diffusion of grout through the more pervious Ogallala beds would not be secured. Rather, the grout concentrated in seams and on bedding planes of least resistance and there flowed away as long as it was pumped into a grout hole. Cement, bentonite, and sodium silicate grout of varying percentage solutions were used with pressures of from 20 to 115 lb per sq in.

FINAL PLAN FOR CURTAIN-WALL CONSTRUCTION

The plan finally adopted to meet the cutoff requirement of this abutment of the dam was the construction of a concrete curtain wall with compacted fill on the water side. This wall was to be built by lifts in a series of superimposed tunnels or drifts, starting on the Brule and rising by increments until the required elevation of the cutoff was reached. With this procedure the top of the ridge, some 90 ft above the flow line of the reservoir, would not be disturbed.

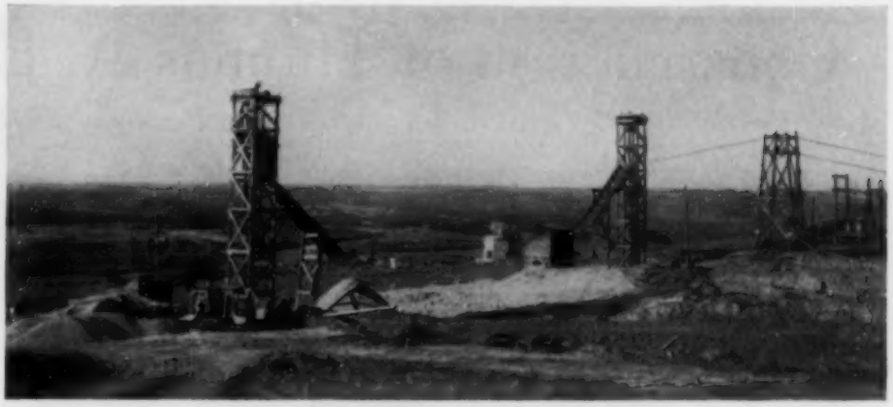
As the ridge had previously been drilled, cored, classified, and logged for a distance of 6,000 ft back from the end of the dam, good information was available regarding the nature and extent of all formations down to the Brule. From these data it was evident that a considerable part of the formation could be tunneled without timbering, and that some part of the tunnel excavation would be suitable for compacted backfill, while the rest would have to be removed from the tunnels and wasted, either on account of its pervious nature or because it would be too hard to compact. Obviously, where original ground



TIMBERED AND UNTIMBERED TUNNEL SECTIONS DURING CURTAIN-WALL CONSTRUCTION
At the Left, Backfilling Has Been Completed and Forms Are Ready for Pouring the Next Lift; At Right, Backfilling a Lift with Imported Material Is Under Way

was unsuitable, imported material would be required for the compacted backfill alongside of the concrete curtain wall.

Design and contract plans called for a tunnel excavation 6 ft wide for pay line without overbreak; a reinforced concrete curtain wall, 1 ft thick, keyed into Brule and poured against undisturbed original ground on the downstream side of the tunnel side wall; and backfilling of all the rest of the tunnel with compacted material. Five-foot lifts of concrete wall were specified.



HEADFRAMES OF SHAFTS ALONG THE TUNNEL LINE

The curtain wall ties onto a concrete core wall which envelops the large outlets under the dam, which in turn ties on to a sheet-pile cutoff wall 9,700 ft long and varying in depth from 40 to 150 ft. All these cutoffs are well keyed into Brule. Each lift of the curtain wall was projected horizontally into a surface cutoff trench which extends to the top of the dam. Thus the outer end of the curtain wall also constitutes a concrete cutoff wall in the trench, which is backfilled with compacted material and bonded to the hydraulic core of the dam.

Additional cutoff features of the Kingsley Dam include: (1) a small rolled core, placed in a cutoff trench excavated along each side of the sheet piling to such depth that there is everywhere a 20-ft lap of compacted core below the top of the piling; (2) a compacted earth blanket 3 ft thick, laid on the upstream foundation of the dam, connected to the rolled core and extending upstream 1,500 ft therefrom; and (3) the main hydraulic core, which envelops and laps over the rolled core and extends to within 10 ft of the top of the dam.

UPPER PART OF FINISHED CURTAIN WALL AND PROJECTION FORMING CUTOFF WALL IN BOTTOM OF CUTOFF TRENCH

Work on the right abutment cutoff was started by drifting into the hill for the full length of the curtain wall (600 ft) on the general elevation of the Brule. To maintain a reasonably level tunnel floor for good working conditions on the first lift, some Brule humps were cut through and low places passed over; later the low spots were trenched into the Brule and concrete was poured in them without forms. Material was transported in 1-yd mine cars. When the first drift was completed, a key trench was cut into the Brule, forms were erected for the curtain wall, and the pour was made.

Then the tunnel roof was stoped down, moistened, and compacted with air hammers in 4 to 6-in. lifts. Thus the tunnel floor was raised until it reached the top of the first lift of the concrete wall; then another lift of wall was poured, and so on.

Above the level of the third lift a large part of the Ogallala formation was so hard it could not be brought to satisfactory density except with an abnormal amount of compaction; hence imported backfill was required. Fortunately the surface soil immediately above the location of the curtain wall was loess, and ideal for this purpose. After some studies of the most economical method of operation, taking into account the probable amount of imported backfill required, it was concluded that operation from two shafts sunk on the tunnel line would prove more economical than routing all materials via the tunnel portal. Accordingly, such shafts, 180 ft deep, were sunk and fully equipped with hoists, and were subsequently largely used for wasting tunnel muck and introducing concrete and prewetted loess.

Total quantities for the curtain wall included 57,250 sq ft of concrete wall, 12,500 cu yd of excavation, and 9,000 cu yd (measured in excavation) of imported backfill. Less than 50% of the job required timbering. Light shooting was done on a small part of the excavation. The wall was completed in 15 months of working time with a small crew of men. As there was no reason for rushing the job, all work was done to best advantage without regard to time.

Contractors' bid prices were as follows: for concrete curtain wall, $0.70 per sq ft; for excavation, $3.50 per cu yd; and for imported backfill, $0.25 per cu yd.

ORGANIZATION AND PERSONNEL

The Kingsley Dam is being constructed by the Central Nebraska Public Power and Irrigation District organized under the state laws of Nebraska. George E. Johnson is chief engineer and general manager; R. O. Green, assistant chief engineer and general manager; W. J. Turnbull, chief soils engineer; and the writer, Geo. N. Carter, is resident engineer on the dam. General contractors are the Minneapolis Dredging Company and the Martin Wunderlich Company, of Minneapolis and St. Paul. George P. Leonard is the general superintendent for the contractors. The District is operating under a loan and grant from the Public Works Administration. The board of consulting engineers employed by the District to collaborate in design and construction consists of H. S. Hunt, president, and Joel D. Justin and William P. Creager.

Construction of Thomas A. Edison Bridge

Erection of 200-Ton Girders Is Outstanding Feature of Work on New Jersey Project

By MORRIS GOODKIND

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PRINCIPAL design features of the Thomas A. Edison Bridge have been described in the August 1940 issue of CIVIL ENGINEERING. It will be recalled that the structure has an over-all length of 4,386 ft and a vertical clearance at the channel span of 135 ft above mean high water. On the north side of the river there are six spans of 152 ft 6 in., and six spans of 84 ft 6 in., all simply supported. On the south side there are eight simple spans of 132 ft 6 in. The main spans across the river are nine in number and consist of one 250-ft channel span and eight spans of 200 ft. The roadway is 52 ft in width.

THE THOMAS A. EDISON BRIDGE
Main Channel Span (250 Ft) in Foreground

For construction of the bridge six contracts were awarded, as follows: (1) river piers, (2) river pier shafts, (3) piers on south approach, (4) piers on north approach, (5) structural steel, and (6) concrete deck and lighting systems. These contracts were let at intervals to insure continuous operations on the various portions of the structure without undue interference. In discussing the work it will be convenient to follow the same divisions.

Contract 1. With the exception of the main channel between Piers 8 and 9 and the span between Piers 9 and 10, the Raritan River at this point is not navigable. It was therefore necessary to dredge a construction channel across the river from the main channel to the south shore to make Piers 1 to 7 accessible. This cross channel was located east of the piers and was made 12 ft deep for a clear width of 100 ft; it was later utilized in the operations of Contracts 2 and 5. The excavation was done with a suction dredge discharging through a 20-in. pipe line and involved the removal of about 50,000 cu yd of material.

The working chambers of structural steel were fabricated and assembled by the Bethlehem Steel Company, shipped to the Long Island City plant of the J. K. Welding Company for complete welding for watertightness, and then towed to the bridge site. Pile guide platforms involving 12 piles each were driven at each end of the pier about 2 ft 6 in. from the cutting edges for the control of the caissons. The build-ups above the steel caissons consisted of 3-in. planking bolted to 6-in. I-beam studding. The use of steel beams was necessary to conform with the provisions of the specifications requiring that no timber be left within the neat lines of the piers if open dredging methods are used.

Pier 4 was sealed by open dredging at El. −85.5 with the cutting edge at El. −78.75. The remaining nine piers required use of compressed air at various stages of their sinking and for their final landing and sealing.

The open dredging was done with a boat 90 by 36 by 10 ft, on which were mounted two steam-operated derricks with 75-ft booms. Both derricks operated simultaneously through three dredging wells, each 8 ft 6 in. in diameter.

A wooden hull 82 by 32 by 10 ft, to which were attached two steel pontoons 4 by 8 by 60 ft for stability, was used as a concrete boat. It was equipped with a 60-cu yd, three-compartment bin for aggregates and a 200-bbl bulk cement hopper. These discharged into weighing batchers and thence into two 1-yd mixers. The concrete was discharged onto a 24-in. belt conveyor, which in turn loaded it onto a 40-ft swinging conveyor. The concrete boat was also equipped with a 400-bbl bulk cement storage bin located aft of the mixers, and the cement was conveyed to the upper hopper by a worm and chain-bucket conveyor. An adequate steam heating plant was also mounted on the boat for cold-weather concreting.

The compressed-air equipment was mounted on a steel hull 88 by 32 by 8 ft in an insulated steel building 26 by 60 ft. The principal units were a 1,200-cu ft and an 1,800-cu ft pneumatic compressor driven by Diesel engines of 150 and 200 hp, respectively, for low pressures. The high air pressure was furnished by an 850-cu ft two-stage compressor driven by a 115-hp Diesel engine. This boat also contained the electric plant, the hospital lock, and the doctor's quarters. The pneumatic equipment for the caissons consisted of four Moran muck locks, two 1-cu yd concrete locks, and two 7 by 12-ft vertical man locks.

The sand hogs were quartered in a houseboat 34 by 80 by 10 ft, fully equipped with showers, toilets, steam heating plant, lockers, and change rooms. On this contract three deck lighters were used to handle materials, and three derrick lighters with 100-ft booms were used for various construction operations.

Contract 2. The contractor for Contract 1 was the successful bidder for Contract 2—river pier shafts—and he utilized much of the same equipment in this work. The principal modifications involved the elevating of equipment and extending of booms to reach the tall sections of the shafts. One of the booms on the double-derrick boat was extended to 150 ft by slipping a steel section over the original timber boom. A gantry was built over the compressor house of the compressor boat, and on it a whirler crane was mounted. This crane was driven by compressed air from equipment previously used for the pneumatic caissons, and its boom had a reach of 155 ft above water level.

SINKING CAISSONS FOR THE RIVER PIERS

A WORKING CHAMBER ON ONE OF THE RIVER PIERS

All concrete in the shafts up to and including the first strut was placed by means of a 40-ft swinging conveyor. One end of this conveyor was mounted on a tower built for the purpose on the mixer boat, and the other end was supported in a boom swivel connected to the tower. The remainder of the concrete was placed by buckets from the long booms.

Contracts 3 and 4. The operations on the piers for the north and south approaches involved usual practices of open cofferdam construction for excavation, and standard methods for pile driving. The contractor for Contract 3 chose to support the strut forms by 20-in. I-beams bolted to the pier shafts, whereas the contractor for Contract 4 used timber bents supported at the ground line. A combination of both methods was used on Contract 2. The concrete for the piers on the north approach, involving two-story frames, was placed by a crane having a boom 125 ft long.

Contract 5. The handling and erection of the girders involved many unusual problems. By reason of their weight, length, and depth, special study had to be given not only to their fabrication in Pottstown but to their shipment to the site, field assembly, and erection.

The first six spans on the north end from Piers 6N to 12N are 85 ft 6 in. long, and offered no difficulty. The girders were shipped by rail to the local yard, delivered to the job by truck and trailer, and erected from the ground by a crane with 60-ft boom and 12-ft jib.

FLOATING CONCRETE PLANT AT WORK BESIDE CAISSON

While these spans were being erected, an additional crane with an 80-ft boom and a 20-ft jib was used to erect the two-boom traveler which was to serve for the longer girders on the north approach and all the river spans. This traveler consisted of two 85-ton stiff-leg derricks mounted as a unit on a rectangular steel frame, 39 ft from center to center of side sills, corresponding to the spacing of the griders, and 62 ft 6 in. from the center line of the mast to the rear tie-down. The mast was 56 ft high and the boom 105 ft long. The traveler was supported on four two-wheel trucks running on 130-lb rails under the side sills and was powered by two 150-hp gasoline engines through three-drum hoisting engines. The topping falls, the main fall, and the runner leads were all $^{7}/_{8}$-in. wire ropes, the topping falls being reeved to 18 parts, the main fall to 9 parts, and the runner used in a single part. The total dead weight of the rig was 260 tons, which was equally distributed to the four trucks, when moving, by swinging the booms to the rear. The traveler was moved out to Pier 6N for its first erection position.

The girders from Pier 10 to Pier 6N are each 154 ft long, weigh 95 tons, and are 15 ft 2 in. deep at the haunches. They were completely fabricated at Pottstown and shipped by rail to a railroad yard at tidewater in Jersey City. Because of their depth and the limited vertical clearances at bridges and electric catenary systems on the railroad, the girders were loaded on three low flat cars with a special drawbar built in the shape of a "U" of box section to accommodate the overhanging haunch. This drawbar had a clearance above the rail of $4^{1}/_{4}$ in. and the top of girder was about 5 in. below the electrification lines, making it necessary to kill the power while these shipments were being made. At Jersey City these girders with their cars were transferred to a 250-ft car float and towed to the bridge site.

While the erection of spans from Pier 6N to Pier 12N was in progress, a floating derrick, especially designed for this project, was constructed in Jersey City. This derrick was mounted on two deck scows, each 121 by 36 ft, fastened side by side. The derrick tower consisted of a triangular structural steel frame, 43 ft wide by 61 ft deep by 86 ft high, with a 77-ft boom. An A-frame 57 ft high was built on top of the tower. The derrick was powered with a 175-hp gasoline engine. It was first used for unloading the 154-ft girders from the car floats, and for this purpose the boom was temporarily stepped into a heel-block above the tower base. Preparatory to un-

HAUNCH GIRDER ASSEMBLED IN SHOP—LENGTH 124 FT 6 IN., MAXIMUM DEPTH 20 FT 6 1/2 IN.

The Horizontal Web Splice Was Made in the Field

loading these girders, a standard-gage track had been laid from the river's edge at Pier 10 to Pier 6N on a maximum grade of 6.5%.

The derrick boat was placed in position at Pier 10, and transferred the girders from the car float to two 4-wheel trucks, on which they were hauled to their proper position under the traveler by a double-drum hoisting engine set on top of the hill. The girders were then lifted into place by the two booms of the traveler, which acted through a balance beam consisting of a 30-in., 190-lb beam, with the pin holes for the falls at 10-ft centers. The balance beam was connected to the girder through a ball-bearing swivel attached to a hitch plate at the center of the girder. After a pair of girders had been set, each boom acted independently in fitting in the floor beams and bracing.

GIRDERS FOR SOUTH APPROACH AND MAIN CROSSING

While these operations were under way, steps were being taken in the erection of the 134-ft 6-in. girders in the eight spans on the south approach between Piers 1S and 1. For this purpose a single-boom traveler of 85-ton capacity, on a triangular frame, was used. It was in effect similar to half the traveler used on the north approach, with one truck over the east girder and two trucks over the west girder. Power was supplied by a 175-hp gasoline engine through a three-drum hoisting engine, and the total dead weight was 157 tons. Erection from below was impractical because of the swampy condition of the ground.

These girders, weighing 67 tons, were shipped by rail to the local freight yard and transported to the site by trailer trucks operating on 32 wheels. A material track consisting of the east traveler rail and an additional rail laid 6 ft 6 in. westerly, on the first line of stringers, was used to deliver the girders and other members on two 4-wheel trucks from the trailer trucks to the traveler. The traveler's first position was over the south abutment, called Pier 1S, from which the first span was set, and it was moved successively to a position over each pier until all eight spans on the south approach had been erected. It was then backed to the abutment, where it was dismantled and removed.

Crossing of the river itself is accomplished by three units of three-span continuous girders, having total lengths of 650 ft, 600 ft, and 600 ft, respectively, from north to south, and extending from Piers 10 to 1. These girders were completely assembled in the shop at Pottstown, but for shipping and handling had to be taken down and reassembled at the bridge site. The first unit was composed of three spans of 200 ft, 250 ft, and 200 ft, with depths at mid-span of 13 ft 0 3/4 in. Each of the 650-ft girders was raised in three sections, the first being 260 ft long and weighing 197 tons without erection devices, and extending from Pier 10 to a 60-ft cantilever beyond Pier 9. The second section was 247 ft long, weighed 179 tons, and cantilevered 57 ft south of Pier 8. The closing section of this unit was 143 ft long, weighed 94 tons, and terminated at Pier 7.

The first section was shipped by rail in three parts to Jersey City and there loaded on car floats to be towed to the site. The haunch girder was about 120 ft long and was divided by a horizontal field web splice; to this was connected the 140-ft piece by a field web-and-flange splice to complete the 260-ft section. The lower portion of the haunch girder was removed from the car float by the two-boom traveler, which had been moved out to Pier 10 and loaded on blocking on a second float. The top section was then lowered between the horizontal splice plates, which were shop riveted to the lower section and the girder riveted up. The flanking section was similarly lowered on to blocking to assure proper profile and alinement, and was assembled with and riveted to the haunch girder.

In preparing the girder for erection the final step was the attachment of a temporary horizontal stiffening truss to the top flange to resist buckling under compression and lateral forces during the erection procedure. It was of the double intersection type, 21 ft deep and centered about the girder flange. There were five panels, each 50 ft long, the compression web members consisting of 8-in W. F. beams at 24 lb, and the diagonal web members of one part of 1-in. wire rope. The chord members were of two parts of 1-in. wire rope. Each cable member was independent and provided with its own turnbuckle for adjustment. Two lifting hitches were then attached to the girder, the one for the two-boom traveler taking 125 tons, and the other for the derrick boat lifting 75 tons.

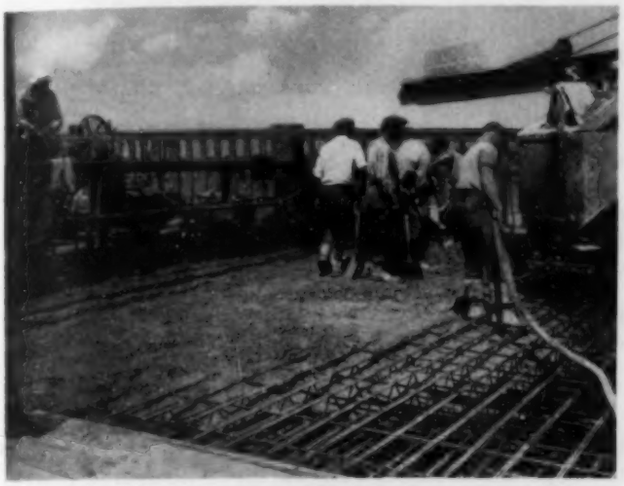
While supported on the float the girder was practically uniformly loaded, and in this condition the stiffening truss was fully tightened. The girder was picked up slowly by the traveler and derrick boat until it was just hanging clear. The trussing was then again adjusted to take up any slack that might have been induced by a change in the loading conditions of the girder. Careful observations were made of the alinement in this position before final word was given for the actual raising. When the girder was landed on its shoes it was immediately lashed to the piers and adjoining span. The trussing was again checked and tightened in this position. The mating girder was handled in a similar manner, and not until the span was adequately braced by floor beams and bracing was the trussing removed.

SPECIAL DRAWBARS WERE REQUIRED TO PERMIT RAIL TRANSPORTATION OF THE 154-FT GIRDERS

Before the traveler could be moved from Pier 10 to Pier 9, preparatory to raising the second section of this

unit, a counterweight affording 2,500 ft-tons was hung from the cantilevered end of the first section to keep the girder stresses from the traveler load within design limits.

While the traveler was still at Pier 10, it assembled the three parts of the 247-ft section. It was then moved out 50 ft south of Pier 9, from which position it lifted this section. The derrick boat landed its end on Pier 8, and only enough holes near the center of the web were bolted at the splice to the first section to transmit the shear with the rig cut loose. Zero moment at the splice was produced by swinging the booms back or by changing the position of the traveler until the holes matched perfectly. The flange and web splices were then fitted up. The last section of the 650-ft girder required no field assembly and was delivered directly to its location between Piers 7 and 8. It was erected without trussing.



DECK POURING AND FINISHING

The erection procedure for the 600-ft continuous girders was similar to that for the 650-ft girders with some minor exceptions. Since the 600-ft girders were only 15 ft 1¾ in. deep and 102 ft long at the haunch section, it was possible to ship this section fully shop assembled, thereby eliminating a horizontal field splice. Each girder was loaded on two flat cars with bolsters spaced at 90 ft, the girder itself serving as a drawbar. The assembly of the flanking section to the haunch section was made in the river south of Pier 10, but since the traveler had been moved out toward Pier 7 it was no longer available for this operation. Tackles were therefore rigged up from the bridge deck 60 ft south of Pier 10. Framework for these tackles consisted of two column sections laid across the girders and stringers and blocked to proper bearing. To these sections blocks and falls 45 ft apart were attached, giving a total lifting capacity of 120 tons. This rigging was used to lift the girder sections from the delivery cars on car floats and to assemble them for the vertical splices. The assembled girders were then delivered to the traveler and derrick boat for erection in a manner similar to that for the 650-ft girders. The traveler was eventually dismantled by the derrick boat.

CONSTRUCTION OF THE CONCRETE DECK

Contract 6. While work on the erection of the structural steel was in progress, the final contract involving the concrete deck and lighting systems was awarded. (Details of the deck were described in the preceding article.) This work involved a total of 6,911 cu yd of concrete of 1:1.75:3.21 mix. By the use of standard road mixing and finishing equipment on the deck, this concrete was placed with a slump of about 1½ in., and test cylinders have shown a 28-day strength of over 5,000 lb per sq in. Particular attention was given to the finish of the grade by means of both transverse and longitudinal screeding to obtain a satisfactory riding surface. As anticipated in the design, full use was made of the reinforcing trusses to support the concreting equipment, consisting of a 27-E paver, a finishing machine, and 3-cu yd batch trucks.

The final items in the completion of the bridge were the installation of the roadway series lighting system, the navigation lighting system fed from the roadway circuit through series multiple transformers, and the traffic-signal lighting system. The operation of the signals was described in the previous article.

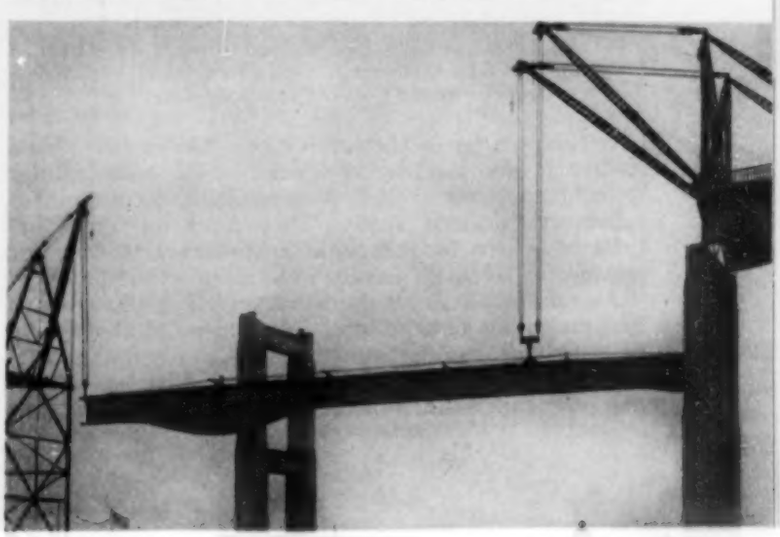
While the design and construction of the bridge involved a number of novel features, and the fabrication and erection of the structural steel were of a pioneering nature in many respects, it is felt that all the advantages claimed in the choice of type for this structure have been realized. Wind conditions play an unusually important part in the erection of long slender girders of the type used on this job, but with due consideration of this hazard there should be no difficulty in the satisfactory handling of such members by properly equipped and competent erection crews.

COSTS AND ACKNOWLEDGMENTS

The following is a tabulation of the various contracts:

Contract 1	$1,157,657.00	The Peter F. Connolly Company
Contract 2	358,598.50	The Peter F. Connolly Company
Contract 3	184,471.35	Fehlhaber Pile Company, Inc.
Contract 4	217,182.10	J. F. Chapman and Son, Inc.
Contract 5	1,708,820.44	The Bethlehem Steel Company
Contract 6	283,081.90	John G. English, Inc., and Joseph Nesto and Company
Total	$3,909,811.29	

The bridge was built by the State of New Jersey with the aid of a grant of 45% from the Public Works Administration. The state is represented by the State Highway Department with E. Donald Sterner, commissioner; James Logan, state highway engineer; and C. F. Bedwell, construction engineer. The work was designed by the Bridge Division under the direction of the writer, with L. C. Petersen, chief draftsman; and W. F. Hunter, senior bridge designer. The design was reviewed by Ash, Howard, Needles and Tammen, consulting engineers. During construction the state was represented by C. L. Appleton, resident engineer; and PWA by F. J. Parker, resident engineer inspector. The erection of structural steel was in direct charge of G. C. Lane, assistant manager of erection, Bethlehem Steel Company. Grateful acknowledgment is hereby made of the keen interest and cooperation displayed throughout the project by the PWA and each of the contractors engaged in the work.



A 260-FT GIRDER, WITH SPECIAL TRUSSING ON TOP FLANGE TO PREVENT

New Steel Shanks for Old Timber Piles

Coal Tipple Pier at Pensacola, Fla., Damaged by Teredo and Limnoria, Renewed Without Disturbing Superstructure

By C. Glenn Cappel

Member American Society of Civil Engineers
Vice-President, W. Horace Williams Company, Inc., New Orleans, La.

PILES have been used in the construction of wharf facilities and other structures in harbors and estuaries for many centuries. Like all the works of man they perform their function until rendered useless from any of a variety of causes.

Aside from abandonment for economic reasons, piles are subject to three general types of destructive agents: decay, mechanical destruction, and attack by marine life. Only in recent years—recent in comparison with the length of time piles have been in use—has any effective defense against these destructive agents been developed. Heretofore the piles were placed and then left to their own devices.

The cure, economically, for decay has been accomplished by treatment with preservatives—principally pressure treatment with creosote. The cure, also economically, for mechanical destruction can be found only in proper design. With respect to marine life, the chief destructive organisms—the teredo and limnoria—have proved themselves to be worthy adversaries, and volumes

Steel Horse-Legs Were Fabricated to Replace Lengths of Wood Piling Destroyed by Marine Life

The 12-In. Length of 10-In. Pipe, Capped with a 1/2-In. Plate and Welded to Two 8-In. Channels to Form a New Shank, Was Forced Over the Round Under-Water Stub of the Pile

have been written on their activities. They seem to have facility in accommodating themselves to surroundings thought prohibitive, and of immunizing themselves to substances deemed toxic. They have an uncomfortable propensity for putting in an appearance at the most unexpected localities and the most inopportune times.

Attacks on piles in harbors of the Gulf of Mexico have long been a major problem. Two general methods have been used for many years in an effort to stop the destruction—treatment of the pile with some toxic substance, and physical exclusion of the destructive organisms.

Toxic treatments have been found only partially effective for the following reasons:

1. The toxin becomes diluted to such an extent that it eventually loses its toxic qualities.
2. Some of the "bugs" seem to become immune to the effects of most of the toxins after a certain time.
3. Timber piles crack from various causes, thereby exposing interior fibers to which the toxin has not penetrated. The toxic method can only be classed as a deterrent.

The methods of physical exclusion used so far have had fundamental weaknesses upon which the "bugs" pounce unerringly.

Mineral Materials Bar Insects

Among the few things we know positively about the teredo and limnoria is the fact that they cannot carry on their operations through any earthy or mineral substance. For this reason, one of the first methods of physical exclusion employed a shell, usually of clay pipe or cast-iron pipe, placed around the pile with an annular space between the pile and the shell. The annular space was filled with sand or some other earthy or mineral substance. This method was very effective as long as the casing stayed in place and the earthy filling remained to interpose an inedible barrier around the pile, but failure occurred when breakage or dislodgment of the rigid shell or opening of the joints allowed the filling to escape. The "bugs" would then go to work under ideal conditions, as the casing, or what remained of it, protected them from outside interference.

With the perfecting of portland-cement concrete for many purposes, "jackets" of concrete were tried to secure physical exclusion. Such jackets, however, were subject to the cracking that inevitably occurs when relatively rigid concrete is placed in direct contact with the more flexible wood. The "bugs" were again invited to work under ideal conditions.

It is evident that an effective protection against destructive marine life should consist of either a toxic treatment and prevention of dilution of the toxin; or physical exclusion which is positive and does not have the weaknesses that have been outlined.

Protection of new installations, however, is only one phase of the problem confronting the engineer. He may also be required to repair structures that have already been subjected to the destructive activities of our marine enemies.

"Bugs" Operate Throughout Wetted Length

The teredo enters the pile, and, leaving his tail at the minute entrance opening, proceeds to elongate himself as he eats his way into the body of the pile, eventually honeycombing the entire interior. His operations may extend from high tide to ground line. He prefers, however, to work near the water surface. I have seen large piles so riddled by teredo that they might be broken over a man's knee.

The limnoria works from the outside, preferably near the bottom, but he too will operate anywhere from water surface to ground line. He rasps the wood away. Large-bodied piles have been cut off entirely, and in some instances have been rasped down to a diameter of 3 or 4 in. for their entire length from water surface to ground line. Needless to say, the teredo and limnoria make fine allies, the limnoria clearing the way for the teredo.

Practically all piers and docks have decks and bracing, and many of them carry warehouses and other types of structures which in many instances represent the major part of the total investment. Replacement of damaged piles is of course the first thought, but superstructure conditions and interference with normal operations often make this prohibitive. Various expedients have therefore been employed in the interest of economy.

FLORIDA EXPERIENCE AFFORDS REPAIR EXAMPLE

An experience with a coal tipple pier at Pensacola, Fla., provides an example in point. This pier was the property of the Frisco Railroad. After a careful underwater survey and at the instance of the company's chief engineer, Colonel F. G. Jonah, the author's firm was employed to undertake the rehabilitation.

The pier was built about twenty-five years ago of creosoted materials of excellent quality. It had given excellent service all these years but was finally about to succumb to the attacks of marine life—teredo and limnoria.

The survey showed that over 30% of the piles in the pier were so weakened that they were of no more practical use. A large proportion of this 30% had been eaten away entirely and was hanging loose. Other piles had been reduced to 3 or 4 in. in diameter. The latter condition existed between the normal high-water line and the ground line. Apparently, the teredo had been in action

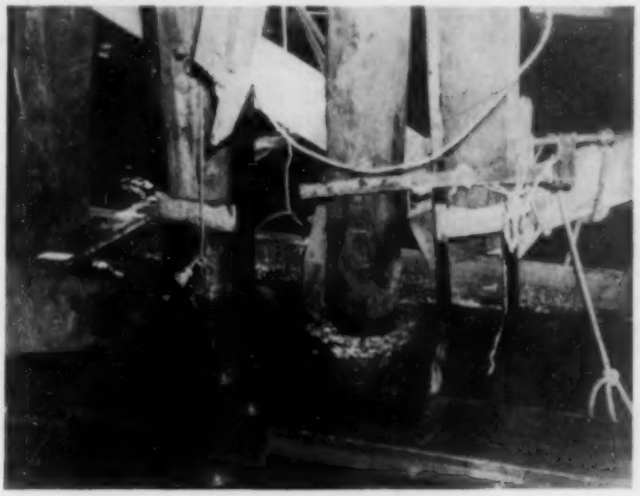
THE SHANK WAS SET WITHOUT DISTURBING BRACES OR SUPERSTRUCTURE

The Dry Stub at the Top Slid Between the Channels as the Cap Descended Over the Wet Stub

considerably longer than the limnoria, but together they had done a very thorough job. Fortunately the pier was not out of line, either vertically or horizontally; hence the problems of jacking and plumbing did not arise.

The survey also showed that the piles were sound below ground line and above normal high water, and that all the timbers, except a few caps and stringers, were sound. A traveling coal tipple on top of the pier made the cost of replacing the piles prohibitive, for such an operation would have necessitated the wrecking of the entire pier.

Our problem therefore was one of devising a method for interposing sound members between the two sound parts of the piles, without interfering with the bracing. This was accomplished by using steel columns fabricated as



JACKING WAS USED TO RELOAD THE OLD STUBS

After the Full Capacity of the 25-Ton Jack Was Applied, the Battens Attached to the Head Plate Were Welded to the Channels, and Drift Bolts Were Driven Through the Dry Stub

shown on the accompanying photographs. At the bottom a 12-in. length of 10-in. pipe was capped with a 12-in. by 12-in. by $^1/_2$-in. plate. To this plate were welded two 8-in. channels, battened so that the top batten would come just about at water level. We then cut off the pile above water where it was sound and just a little below the ground line, where it was likewise sound. The steel horse-leg was placed over the bottom part of the pile and around the upper part of the pile, clearing the braces. A 25-ton jack was next based on the top battens about at water level with a $^3/_8$-in. plate welded to battens on top of the jack up against the butt of the upper part of the pile.

Then the whole was jacked until the 10-in. pipe had been forced down over the lower end of the pile for the full 12 in. of its length. Jacking was continued until the full 25-ton capacity was taken up. The battens attached to the head plate were next welded to the 8-in. channels, and the 8-in. channels were bolted through the upper part of the pile. Two drift bolts were finally driven through the plate attached to the short piece of pipe and into the bottom part of the pile.

LIFE OF SOUND STRUCTURE GOVERNS NEW DESIGN

After this operation had been completed, we had, to all intents and purposes, a new pile, at least a composite pile as strong as a new pile would have been at any point in its length. The weight of metal used in the various sections was based on the useful life expectancy of the rest of the structure.

The steel is protected by a good grade of bituminous paint and should give excellent service over a period of many years.

The foregoing procedure embodied a very considerable advantage in making it unnecessary to dismantle the pier or cut it up badly in order to get new piles in. The method may be of interest to other engineers who must find an economical method of replacing, or rehabilitating structures that have some piles gone or very badly weakened and some still in sound and usable condition. The idea is not of course recommended for new construction.

Parker Dam Power Project

By J. A. FRAPS

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ENGINEER, U.S. BUREAU OF RECLAMATION, PARKER DAM, CALIF.

MUCH earlier than expected, power facilities are being added to Parker Dam, to utilize the 70-ft head of the Colorado River created when that structure was completed in 1938. Excavation, machinery, and penstocks are taken care of under contract but concreting and installation are by force account. Leading east and south, several hundred miles of power line serve the Phoenix and Yuma districts. Over this line Boulder Dam power is already being made available, pending completion of the Parker plant.

WHEN Parker Dam was completed in 1938 no one thought there would be need for the construction of the Parker power plant before 1948, or possibly much later. But Nature has a way of making necessary the revision of even the most carefully conceived plans of men. In the present case this revision was brought about by a protracted drought in central Arizona, with a resulting shortage of water and electrical power for an area that supports more than half the total population of the state. It is for this reason that the Parker Dam power project was started nearly a decade earlier than had been anticipated.

Negotiations leading to the construction of the project involved four agencies. Contracts were entered into between the United States, the Metropolitan Water District of Southern California, the Salt River Valley Water Users' Association operating the Salt River Project–Arizona, and the Central Arizona Light and Power Company of Phoenix, Ariz. In general, these contracts provide for the immediate construction of the Parker power plant and two transmission lines, one east from Parker Dam to Phoenix and one south to Blaisdell, Ariz. (near Yuma). Provisions were made in these contracts for immediate transmission of Boulder Dam power over the Metropolitan lines to Parker Dam, thence over the new Bureau of Reclamation line to Phoenix. This hook-up will be discontinued when the Parker power plant goes into operation. Power will be supplied to the Salt River Valley Water Users' Association and to the Central Arizona Light and Power Company. Each will be entitled to receive 30,000 kva for 20 years and each will make a minimum annual payment of $220,000. Power will also be furnished to the U.S. Indian Service at Parker, Ariz., and to the Gila Project near Yuma. Revenue from the sale of power will be used to defray the cost of the Parker Dam power project.

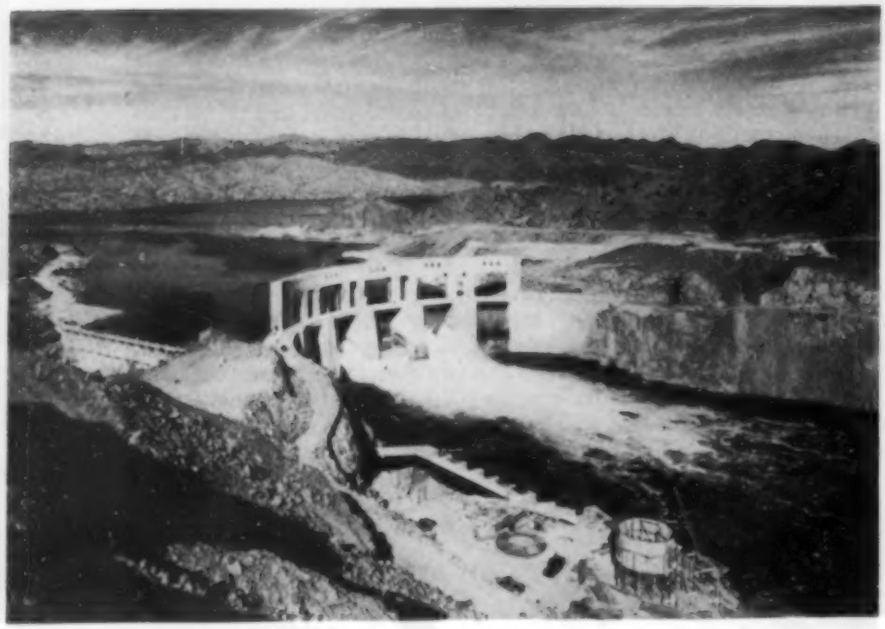
Parker Dam was built by the Bureau of Reclamation under a contract with the Metropolitan Water District of Southern California. Its chief purpose is to form a lake from which water will be pumped and started on its way to the Los Angeles metropolitan area, 267 miles away. Under the provisions of the contract, the Metropolitan Water District and the United States will share equally the power rights at the dam. Construction costs of Parker Dam have been assumed by the District.

The design of Parker Dam was made by the Denver office of the Bureau of Reclamation. The structure is of the concrete arch type with a maximum height of 320 ft, of which 235 ft are below the original river bed. Each of the five spillway openings, located along the center of the crest of the dam, is controlled by a 50 by 50-ft structural steel gate weighing 100 tons and operated from a reinforced concrete house constructed above and upstream from the roadway across the crest of the dam. A reinforced concrete trash-rack structure, a portion of the forebay, and the foundation for the power house were included with the construction of the dam.

Every dam seems to have some distinctive feature that sets it apart from others. Parker Dam bids for fame because its foundation rock is 235 ft below the original stream bed. The river was diverted through two 29-ft horseshoe-shaped tunnels which were drilled around the left abutment of the dam; then earth-fill cofferdams were built in the river channel upstream and downstream from the dam site. One sudden heavy flood from the Bill Williams River, which enters the Colorado River only a quarter of a mile upstream from the dam site, almost caused a disaster to the partly completed excavation during the construction period. Flood water rose to within a few feet of the top of the earth cofferdam but the temporary structure did not fail.

Concrete was placed in the dam during the summer of 1937. The structure was divided into a number of 50-ft panels, separated by vertical, radial contraction joints. Pipes were embedded in the concrete and river water was circulated through the pipes to cool the concrete. All contraction joints were pressure grouted after the desired cooling was effected. Foundation rock was also grouted under heavy pressure.

Under the present construction program, it is planned to install three 30,000-kva generators and three 40,000-hp hydraulic turbines, and to house these units in a power station (Fig. 1) that will later accommodate a fourth



U.S. Bureau of Reclamation

PARKER DAM POWER PROJECT UNDER WAY

Trash-Rack Structure at Entrance to Forebay Appears Above Dam at Left; Power House Foundation Below Dam, near Site. Both Were Included in Original Dam Construction

U.S. Bureau of Reclamation

CONCRETE BATCHING AND MIXING PLANT
Gravity System Leads to Pumpcrete Machines at Base

unit of the same capacity. Four penstocks 22 ft in diameter are to be placed between the forebay and the power house, passing through short tunnels in the right abutment of the dam. A switch yard is to be built high up on the right (west) abutment. A part of the work on the power plant is to be performed by contract and a part is to be accomplished by government forces.

A contract was let in November 1939 to Clyde W. Wood of Los Angeles, Calif., for the excavation of 230,000 cu yd of rock in the forebay, 85,000 cu yd in the switch yard, 6,000 cu yd in the power house, and approximately 800 ft of 26-ft-diameter tunnels with steel supports and liner plates to prevent injuries to workmen during construction. All items are practically finished. The contract price for open-cut excavation in the switch yard and forebay was $0.48 per cu yd; power-house excavation was $2.00 per cu yd, and tunnel excavation was $5.90 per cu yd plus $0.09 per lb for metal supports and liners. A very efficient and highly mechanized contractors' organization has prosecuted this work.

Three hydraulic turbines of 40,000 hp each are being furnished by the S. Morgan Smith Company. The contract delivered price for the three units is $794,014.42. Each turbine rotates at 94.7 rpm and is of the vertical-shaft, single-runner, cast-steel, Francis type. The scroll cases are of plate steel. The water surface in the reservoir is ordinarily at an elevation 70 ft higher than the tailrace water elevation, at a discharge of 5,000 cu ft per sec. The turbine manufacturer has guaranteed an efficiency of 90% for heads of 70 and 80 ft.

Obviously, turbines of such large output, operating under relatively low heads, involve special problems of manufacture. The turbines are even larger than those now in operation at Boulder Dam, greater size being required at Parker by virtue of the relation between head and power output. Each turbine is completely assembled in the shop, then taken apart for shipment to the job.

The Westinghouse Electric and Manufacturing Company was low bidder on three 30,000-kva generators, with a bid of $1,097,515 f.o.b. East Pittsburgh, Pa. Each generator rotates at 94.7 rpm, and operates at 6,900-v, 3-phase, 60-cycle alternating current. The shaft is vertical, and is equipped with thrust and upper and lower guide bearings. The manufacturer guarantees 97.2% efficiency at 100% rated output and unity power factor. Cooling of the generators is to be effected by means of an enclosed cooling system. Cold water is circulated through copper tubes, and fans on the generator rotor force air through the machine.

It was decided to perform by contract the processing of concrete aggregates. Suitable deposits were discovered on the Arizona side of the river one mile downstream from the dam. A contract price of $33,870 was obtained for processing and stockpiling at the plant sufficient materials for 60,000 cu yd of concrete.

Aggregates are divided into sand and three sizes of rock—$^1/_4$ to $^3/_4$ in., $^3/_4$ to $1^1/_2$ in., and $1^1/_2$ to 3 in. Concrete will be placed with a pumpcrete machine which will not handle material larger than 3 in. All material is washed. The usual Bureau of Reclamation requirements as to sand and rock grading, deleterious substances, undersized and oversized material, and sampling and testing are included in the specifications for aggregate processing.

For furnishing and erecting four 22-ft-diameter, welded plate-steel penstocks, aggregating 700 ft in length, the low bidder was the Chicago Bridge and Iron Company and the delivered cost of the work was $200,824. This 22-ft-diameter pipe has a shell thickness of $^5/_8$ in. with heavy support and stiffener rings spaced at intervals of from 2 ft 6 in. to 3 ft 4 in.

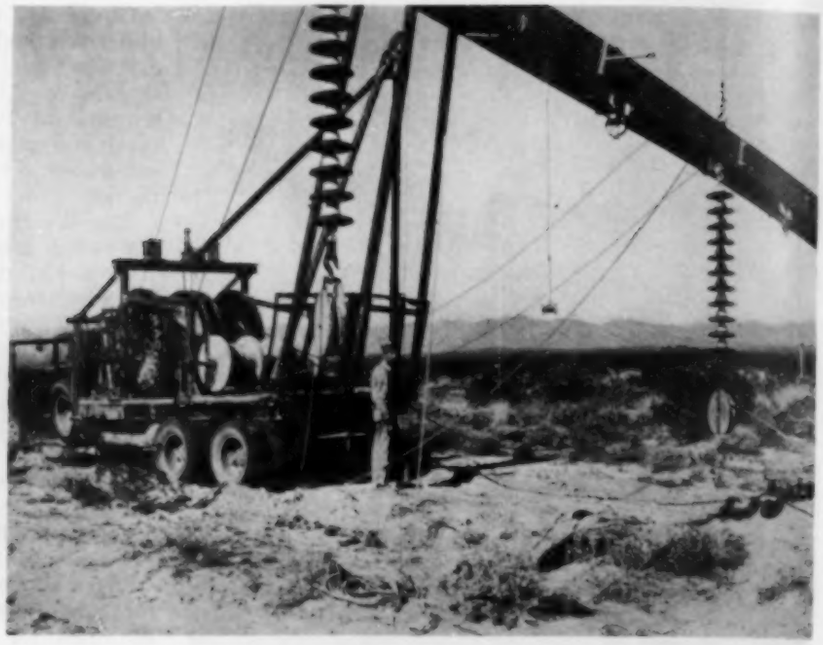
Flat plates will be delivered to the job and there rolled and welded; then support and stiffener rings will be added to make pipe sections 20 ft long. Automatic welding is required in the field fabricating plant. The 20-ft sections of pipe will be placed in the tunnels or in the open-cut trenches between the downstream tunnel portal and the turbine scroll case. The pipe will then be jacked into position, tied to the rock, and welded at the 20-ft circumferential joints. Later it will be encased in concrete by government force-account crews.

U.S. Bureau of Reclamation

EXCAVATION IN PROGRESS AT WEST END OF DAM
Preparations Under Way to Build the Power Plant: Near Hill Is Being Removed to Provide for Forebay; High Bench Is for Switch Yard

U. S. Bureau of Reclamation

DIGGER MOUNTED ON TRUCK MAKES SHORT WORK OF EXCAVATION FOR DESERT POST HOLES



U. S. Bureau of Reclamation

WOODEN CROSS-ARM ASSEMBLED FOR POWER LINE
Insulators and Conductor Cables Will Be Raised at Same Time

All shop and field welds of both longitudinal and girth joints will be radiographed for the entire length of the joints. Any defective sections in the welds will be chipped out, replaced, and again radiographed. Suitable field tests are provided for prequalification of welders and also for all welded joints.

Another item of more than usual interest is the 200-ton traveling crane, which will run the entire length of the power house and will be able to take out any unit and carry it to the downstream end of the power house for necessary repairs. Crane rails are spaced 59 ft 6 in. from center to center. This space is spanned by a pair of built-up girders, on which will be placed two synchronized 100-ton hoists and hooks. Each hoist will also have an auxiliary 20-ton hook. Operation will be electrical. A low bid of $53,933.39 was received by the Cyclops Iron Works of San Francisco for the fabrication of this crane.

All work in addition to the items already discussed is to be performed by government forces. The largest single item will be the placing of 60,000 cu yd of concrete in the power house, between the steel penstocks and rock in the four tunnels, around the inlet portals to the tunnels, and in the switch yard. A concrete batching and mixing plant has been built along the face of a steep rock slope near the downstream end of the power house. Aggregate storage bins and a 2,000-bbl cement silo are at the top of the rock slope. Aggregates flow by gravity to hand-operated weigh batchers; cement is transported laterally by means of a screw conveyor and then flows by gravity to the cement weigh batcher. Materials flow by gravity from the weigh batchers into a 2-cu yd tilting mixer which discharges directly into the agitator hoppers of two Model-200 single pumpcrete machines. Except for a small amount of concrete in the switch yard, which can be most economically delivered by truck, all concrete will be transported through the 8-in. discharge pipes of the pumpcrete machines. Small compact sections of the concrete will be placed by depositing directly from the pumpcrete lines to the forms; but the areas are usually so large that buggies will be required for distribution.

A large part of the cost of the concrete is always represented by the cost of forms. One of the most difficult jobs of forming will be for the draft tubes. If this form were imagined to be completely built, it would fit nicely into a 60-ft cubical box. This means, of course, that it cannot be assembled in the shop. All circular rings will be cut in the shop and assembled into sections as large as can be transported and placed. On straight walls, columns, and floors, form panels will be used whenever possible. These panels will be lined with plywood for the power-house substructure. It is required, however, that for concrete in the power-house superstructure, which is that portion of the building above the generator

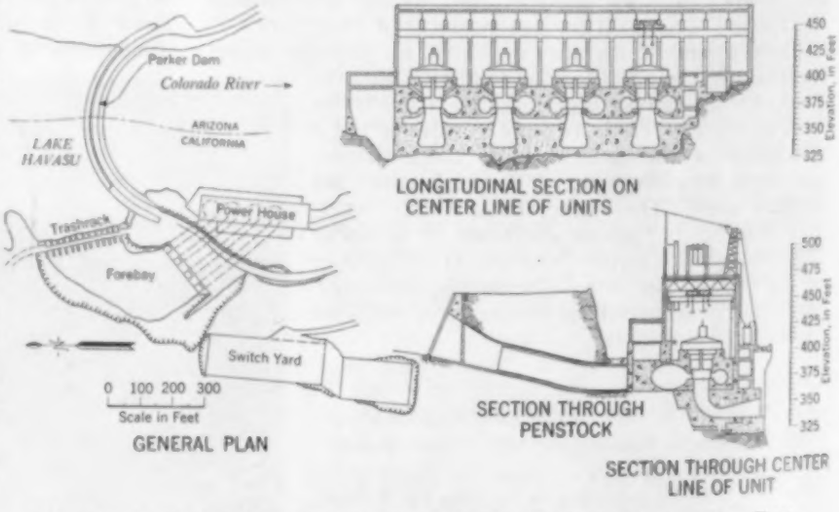


FIG. 1. PLAN AND SECTIONS OF PARKER POWER PLANT IN RELATION TO DAM

floor, all forms must be lined with absorptive form lining. This is nothing more nor less than a specially treated wallboard; its purpose is to absorb the water that usually collects at all formed surfaces, thus reducing the water-cement ratio of the surface concrete and leaving an extremely hard exposed concrete.

Another main item of force-account work will be the installation of the turbines and generators. This work will be done by government workmen, although the manufacturer will furnish erection engineers to supervise it. Installation of the traveling crane in the power house, a traveling gantry to raise and lower a steel gate over the upstream end of the penstocks, switch-yard equipment, power-plant transformers, station equipment, and many minor items of work will also be done by government forces.

U.S. Bureau of Reclamation

ERECTION OF POWER BENTS
Previously Prepared Cross-Arms Being Attached to Pair of 60-Ft Poles

Concrete will first be placed in the power-house substructure, that is, below the generator floor. The construction schedule will not permit all substructure concrete to be placed at once; some will have to be deferred until the hydraulic turbines are installed, and 420 days are required to fabricate the first turbine. This means that all concrete may be placed to the top of the draft tubes, but from that point to the generator floor blockouts must be left for the turbines and scroll cases. Concrete above the generator floor will be placed before the turbines are installed. If possible, the traveling crane in the power house will be used to handle the turbines and scroll cases during installation. The last concrete to be placed will be the mass concrete around the turbines and scroll cases.

Aside from the concrete batching, mixing, and placing equipment already mentioned, the main items of construction equipment are: one $^{3}/_{4}$-cu yd heavy-duty dragline crane with 40-ft boom; one 1-cu yd heavy-duty dragline crane with 50-ft boom; two 370-cu ft air compressors; one 24-in. engine lathe; two 4,500-gpm unwatering pumps; and rock drills, paving breakers, sump pumps, concrete vibrators, and numerous minor items.

It was obvious early in 1939 that a severe shortage of power and water would be experienced in the Salt River valley before the end of that year. Boulder Dam power was available, however, at the Gene Substation of the Metropolitan Water District, two miles west of Parker Dam. Every effort was made, therefore, to expedite the construction of a power transmission line from Parker Dam to Phoenix to relieve as much as possible the shortage of power in the Salt River valley.

Surveys were started for the Phoenix–Parker Dam line in March 1939. Bids for the construction of this line and also for the Parker Dam–Blaisdell line were received on June 6, 1939. Dwight Chapin, Jr., was low bidder on this work, with a bid of $209,694 for the 260 miles of line. Materials for the line were furnished by the government.

The transmission lines are 161,000-v, 3-phase, single-circuit, 60-cycle, supported on wood-pole, H-frame construction. Design assumptions for the conductor were a light loading condition of no ice and a wind pressure of 12 lb per sq ft at 30 F. Conductors are hollow-core copper of 300,000 circular mil size.

Lightning is unusually severe in the region traversed by the Parker Dam–Phoenix line. To insure service that will be as nearly continuous as possible, more than usual precautions were taken. Two overhead ground wires of $^{3}/_{8}$-in. galvanized steel strand run the entire length of the line. A continuous longitudinal counterpoise consisting of two $^{1}/_{4}$-in. copper rods or wires is buried 24 in. below the surface of the ground. A connection is made between the overhead ground wires and the counterpoise at every pole by means of a $^{5}/_{16}$-in. galvanized steel wire. In addition, the butt of each pole is wrapped with $^{1}/_{4}$-in. copper wire and connected to the overhead and counterpoise ground wires.

Temporary breaks in power service on the Parker Dam–Blaisdell line are of less importance than on the Phoenix line. Hence a less elaborate system of ground wires was used. Each pole is provided with a $^{5}/_{16}$-in. steel ground wire, which is connected to a $^{1}/_{4}$-in. copper wire wrapped around the butt of the pole.

Construction of the power transmission lines was started in August 1939. The contractor brought to the job a large variety of special equipment. Post holes were dug by a machine borer mounted on the back of a heavy-duty, four-wheel-drive truck. This truck was also equipped with a crane, and as soon as a hole was bored this crane hoisted a pole into it. The two 4-in. by 12-in. by 35-ft cross-arms and three insulators were assembled on the ground and all ground wires and conductors were attached. This entire assembly was then hoisted into place by the heavy truck crane. Conductors were run through snatch-blocks at the bottom of the insulators. The conductors were then sagged into final position, clamped to the insulators, and the snatch-blocks removed. A heavy rooter pulled by a tractor laid the counterpoise wire at a depth of 2 ft below the surface of the ground, and backfilled the trench in one operation.

The Phoenix–Parker Dam line was placed in operation on January 31, 1940. It is now supplying the Phoenix area with 20,000 kva of Boulder Dam power. The present voltage on this line is 66,000.

The Parker Dam–Blaisdell line has been completed but will not be placed in service until power becomes available at the Parker Dam power plant.

The Parker Dam power project is being constructed by the U.S. Bureau of Reclamation, in which organization John C. Page is commissioner, S. O. Harper, is chief engineer (both Members Am. Soc. C.E.), and L. N. McClellan is chief electrical engineer. Work in the field is under the direction of E. C. Koppen, M. Am. Soc. C.E., construction engineer. The construction of the power transmission lines has been under the supervision of Allen Mattison, division engineer.

Modern Developments in Towboats and Barges for Inland Waterways

A Paper from the Waterways Division Program at the 1940 Spring Meeting

By ALEX. W. DANN

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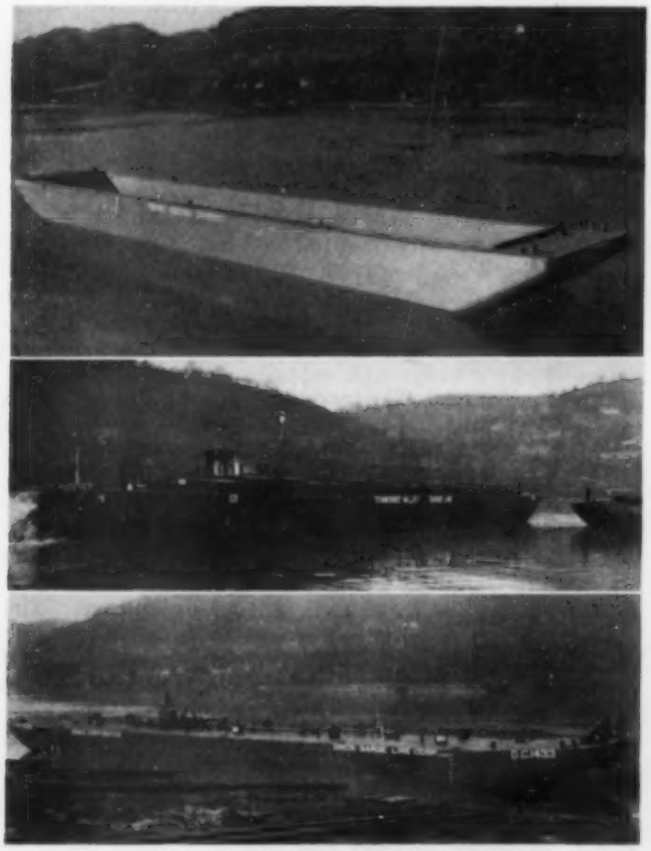
CANALIZATION of the Ohio River from Cairo to Pittsburgh and of the upper Mississippi to Minneapolis, open-channel improvement of the lower Mississippi and the Missouri, and development of a protected channel along the Gulf coast from New Orleans to Houston, together provide a 6,000-mile water highway along which freight tonnage is steadily increasing. This redevelopment of water transportation has caused river operators to scrutinize more closely the costs of operation and the elements affecting those costs. Time and performance studies, model testing, and other research have led to a variety of improvements both in barges and in towboats, as well as in the channels upon which they must operate. It is the purpose of this paper to discuss some of the progress that has been made.

Early movements of freight on inland waterways were mainly downstream. Barges were constructed of light timber and lumber, with little thought for easy running qualities. Barges were seldom brought back upstream but were dismantled and the material used for other purposes. When the growing shortage of lumber brought about the return of the "empties," more thought was given to design to provide minimum water resistance on the upstream passage. Steel was substituted for wood about 1912. Design and shape were based upon experience with wood, and riveted construction was used. Between that time and the beginning of the last decade, design was improved, with general use of heavier plates and more closely spaced frames. Easier running qualities were introduced, based largely on individual ideas without much resort to research and investigation. During the 1930's, there came about a rather sudden and almost complete application of welding. This has meant a redesign and general simplification of structure. Welded barges have proved their superiority over the riveted type. They survive and protect their cargo better in case of collision or mishap, and they have no loose leaky rivets to cause trouble as they grow older.



THE THREE GENERAL TYPES OF RIVER BARGES
Top: A Welded Steel Coal Barge with Improved Rake Ends. Center: Double-Bottom Welded Steel Cargo Barge with Watertight Roller Hatches. Bottom: A Liquid Carrier

Barges are built to handle cargo of three general classifications. In the first are commodities that do not require protection from the weather. These include coal, sulfur, pipe, fabricated steel, scrap iron, fluorspar, sand, and gravel. The two last named are usually carried on deck barges, in which the bottom of the load is flush with the gunwales, permitting the wash water to run off. Barges for this service vary in size from 100 ft by 26 ft 6 in. by 6 ft 6 in. to a general maximum of 135 by 30 by 8 ft, holding 300 to 600 tons. Because of the low consumption of these commodities in recent years comparatively few barges have been built for this service. When construction is resumed, we are likely to see improved and simplified design incorporating the cargo box integral with the hull to secure lower maintenance cost. Another type of open barge is the hopper barge, which carries its load mainly below the water line and on the floor members. Standardization in size, to a large extent, has been accomplished at 175 by 26 by 11 ft. These dimensions are such that four barges fill one of the 56 by 360-ft locks on tributary streams. Departure from this size has recently been observed in the construction of a fleet having the same depth and width but a length of 210 ft. The standard barge carries 900 to 1,000 tons of coal, and the 210-ft one, 1,100 to 1,200 tons. Some companies have departed from the standard size for use on rivers with larger locks or no locks, using 195 by 35 by 11-ft barges, carrying 1,300 to 1,400 tons of coal.

The second class of barges carries solid commodities requiring protection from the weather, such as general merchandise, tinplate, matches, nails, and cotton. In this group sizes vary from 300 by 52 by 12 ft to 132 by 35 by 10 ft, or 150 by 26 by 10 ft. A recent attempt at standardization at 175 by 26 by 11 ft has been made. Many of these barges have double bottoms and sides for additional cargo protection. The load is usually carried below the water line on the floor members. A recent

change in the 175 by 26 by 11-ft barge is the provision of a double bottom with a hopper arrangement at the sides and ends of the cargo space, effecting double protection to about 87% of the wetted surface area at a 7-ft draft. Some economies in construction are thereby accomplished.

The third class of barge carries liquid cargoes such as petroleum products, vegetable oils, acids, molasses, and tar products. Again we meet a variety of sizes, but the tendency is to standardize at 195 by 35 by 10 ft where smaller locks are not encountered, and at 175 by 26 by 11 where passage must be made through 56 by 360-ft locks. One type carries cargo in the hull, which is divided into sufficient compartments to accommodate different grades and to prevent rolling. The deck supports expansion trunks, pumps, and piping for loading and discharging. The trend is to substitute gasoline or Diesel-engine-driven pumps for steam-driven pumps. Another type carries cargo in cylindrical tanks, not integral with the barge but placed in hoppers of standard size and fastened to them. The carrying capacity of liquid-cargo barges varies from 300 to 1,200 tons.

Current improvements, aside from the application of welding and simplified design, include the use in the hopper-type barge of 60-lb rail at the gunwale to protect against clamshell buckets, and a wider gunwale to provide greater strength with less weight, hence greater carrying capacity for the same size and draft. The wider gunwale also provides an ample walkway, and a safer and better working space for the crew. Use of roller hatches instead of lift hatches on covered barges expedites loading and unloading and provides more protection for valuable cargo in case of sudden rain while loading or unloading. These covers are built watertight, in sections that can be readily telescoped to expose at least one-third of the cargo space at one time over the full width of the barge. Liquid cargo carriers have added provisions for safety against fire and explosion and better facilities for complete unloading of cargo. When required, heating coils are installed.

The greatest advance in the design of barges has been in the change of shape—particularly the use of fuller and shorter rakes with rake bilge and shear modifications. The amount of water coming aboard when running in swells is greatly decreased, as is the water resistance. The amount of power necessary to push a barge or barges at a given speed against a current of constant velocity has been found to be reduced as much as 45 to 60% in the newer designs as compared with some older ones. A reduction of 20 to 30% in the power required is sometimes observed even over fairly recent designs.

Except in tidal coastal waters, movements are made exclusively in flotillas. The barges are lashed rigidly together in front of the towboat so that all move as one unit. The strong currents encountered are helpful to downstream progress if the towboat has sufficient power and maneuverability to safely negotiate the bends and the locks.

STERN-WHEELERS MAINTAIN GOOD TOWING ABILITY WHEN OVERLOADED OR RUNNING WITH A HIGH PERCENTAGE OF SLIP

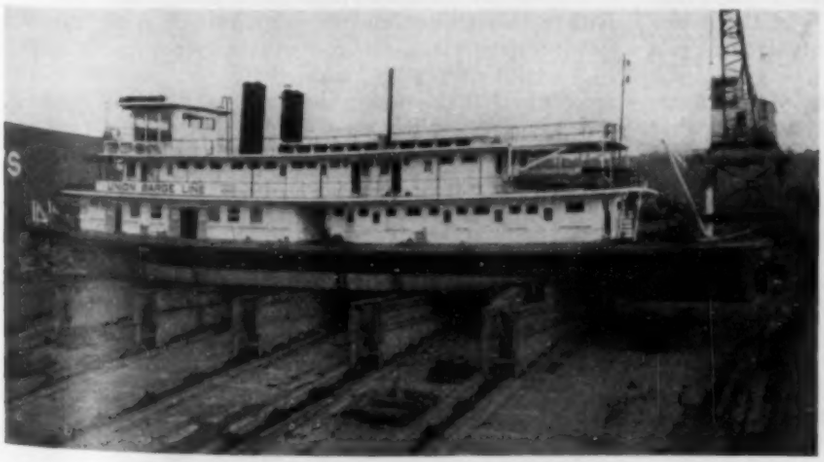
STERN-WHEELERS AND OTHER TOWBOATS

The familiar stern-wheel towboat appears in any picture depicting the romance and business of the waterways. Its development from a wood-burning, low-pressure, non-condensing power plant to a coal or oil-burning, high-pressure, condensing power plant has taken place over a long period of time. This towboat is an outstanding example of a power unit developed to perform a particular job. The job has been to push and pull barges over a shallow, shifting channel, and by "shallow" we mean of less than 9-ft depth. Good stern-wheelers have been constructed in many sizes and for drafts as shallow as 3 to 5 ft. They maintain good towing ability when overloaded or running at reduced speed with high percentage of slip, and the rudders placed forward of the wheel develop large twisting and flanking effort when the engines are in reverse.

Now the 9-ft channel has become widely available and it may be expected that future channels will be maintained at an even greater depth. The 9-ft depth has made it possible to develop towboats with screw propulsion having greater efficiency because of their greater draft. For the shallower channels, use of the stern-wheeler is still indicated. But for channels of 9 ft or over, we are inclined to use the screw-propeller working in a tunnel.

Early river tunnel boats were built with wheel immersion in still water as low as 55 to 60%, on account of restricted channel depths. This made it difficult to get good wheel efficiencies and suitable rudder arrangements to accomplish good flanking and steering in reverse, and the boats were apt to be clumsy and unreliable when handling flotillas through locks or in difficult reaches. Their power astern—that very necessary factor for safety and reliability—was greater at the same horsepower than that developed by the stern-wheeler, but still seldom exceeded 70% of their full power ahead.

A good towboat, making use of up to 750 hp per screw to operate on



THIS MODERN DIESEL-POWERED TWIN-SCREW TOWBOAT HAS JUST BEEN EQUIPPED WITH KORT NOZZLES TO INCREASE TOWING ABILITY

channels 9 ft deep or better, will have a draft at the wheel of about 6 ft 9 in., trimming deeper at the bow in operation. It will have four-bladed propellers, either detachable or integral with the hub. The ratio of pitch to diameter may vary between 65 and 80%, dependent upon conditions of use. The wheel will have not less than 80% still-water immersion. Also, in designing the tunnel, proper regard must be had for access of water to the wheel and its departure from the wheel. This factor has, moreover, a very important bearing upon the action of the water on the rudders, which in turn determines steering and handling ability, both forward and astern. The push-and-pull performance of boats of a given horsepower may vary as much as 30% depending upon the design of the stern.

A MODERN RIVER FLOTILLA OF WELL-SHAPED BARGES

An important development in towboat design is the use of the Kort nozzle. This is a device for increasing towing ability and consists essentially of a cylindrical body, constructed of formed and welded steel plates, enshrouding the propeller. Its purpose is to guide the water to the propeller and concentrate the action of the propelled water aft of the wheel. Its installation permits the addition of more tonnage to the flotilla or the use of a towboat with 15 to 30% less rated horsepower for a given towing assignment. The nozzle was first used on foreign vessels performing duties different from those here required, and in its original form there was some decrease in pull at full speed astern. Its application to western river towboats has consequently been the subject of model basin experiments. Its development has been carried to the point where more than 90% of the power ahead is available astern, and steering both forward and astern is exceptionally good.

Main power plants designed for the use of steam are now available, although their economy is somewhat limited because of their small size. The Diesel engine, with continually improved design and construction, is also used. Choice is influenced by the first cost and by the availability of bunker oil or coal for steam generation and distillate for Diesel operation. The advantage for long-distance operation lies with Diesel units because of the much smaller tonnage of fuel required for each day's operation. This point influences hull size and consequently first cost.

In addition to prime movers direct connected to the wheel, there are alternate designs, each with its own advantages. These include Diesel electric power, with motors mounted on line shafts; higher-speed Diesels, with gear reduction to provide best wheel speed; and steam plant with turbines geared to the wheel shaft.

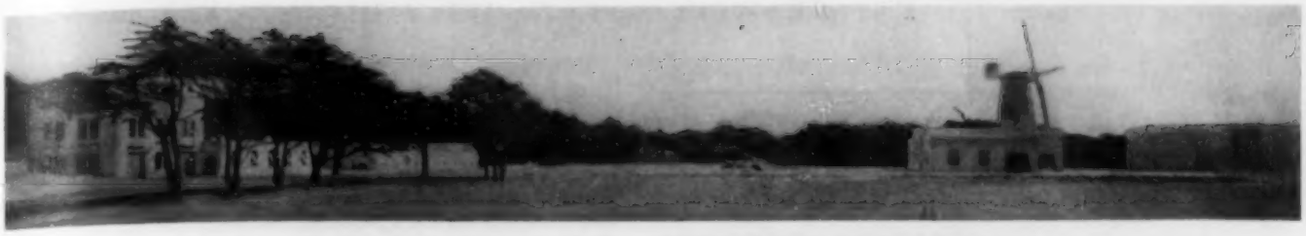
Because of its greater permissible draft, the modern towboat has a smaller water area than earlier boats with the same push and pull. More attention is being paid to conveniences of operation and to the comfort and safety of the crew. Direct two-way shore communication is not uncommon and voice communication within the boat and to the flotilla is almost standard practice with large tows. The living and working quarters for the crew are often partially or fully air-conditioned, and an effort is made to provide living quarters having the comforts of any well-regulated home.

We have seen the performance of a given towboat in a given service increased by almost 70% without the addition of power plant, through the use of better barges and Kort nozzles. A measure of the credit for such improvement is of course due to improved river conditions; the remainder must go to better design and construction of floating equipment and more understanding of the proper formation of flotillas and the grouping of barges ahead of the towboat.

Research along these lines has included the use of model basins, with models run at varying speeds. This work has encouraged the building of new equipment, the improved performance of which in actual service has been quickly observable in running-time records. A careful check of results has also been made with the dynamometer barge, a piece of testing equipment that is worthy of special mention. For a long time it has been possible to test the performance of a towboat operating at dock with 100% slip or of a towboat pulling flotilla behind it with manila line or cable. The dynamometer barge now provides a means of measuring actual push and pull when a towboat is operating in its usual service. The towboat is lashed to the dynamometer barge, which in turn is incorporated in the flotilla to be towed. Repeated operations upstream and down provide direct readings of water resistance encountered by the barge or barges and the ability of the towboat to exert push at good towing speeds and pull for the purpose of stopping the flotilla and bringing it astern. The dynamometer barge is also used for 100%-slip dock tests and for the determination at dock of steering and flanking performance.

ECONOMY OF DEEP CHANNELS

Experience indicates definitely the greater economy with which freight can be transported on a channel of not less than 9 ft. The cost of transportation on streams $5\frac{1}{2}$ to 6 ft deep is so much greater that it compels us to conclude that the design depths of all channels should be 9 ft or more. When we consider that the first objective of river improvement a century ago was to provide 24 in. of water, and that now we are operating on 9 ft, it is not hard to believe that our rivers will some day carry barges with much greater draft than they do now. Wider and deeper channels, better barges and towboats, and more skillful crews will increase the amount of freight handled in each flotilla, and this in turn will mean towboats of increasingly greater push and pull. The tendency is to increase the size of the individual barge, making it within reasonable limits as large as the locks and assured cargo will permit. Larger units in the flotilla cause less disturbance to the water and thus require less horsepower to handle a given tonnage. Such flotillas will steer and maneuver more easily and, in general, will require a lower capital investment per ton of paid cargo.



RICHMOND–SUNSET SEWAGE TREATMENT PLANT IN GOLDEN GATE PARK
Pretreatment Building and Mixing and Sedimentation Building at Left; Main Building and Sludge Digester at Right

First Year's Operation of Richmond–Sunset Sewage Treatment Plant

By B. BENAS
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SUPERINTENDENT, RICHMOND–SUNSET SEWAGE TREATMENT PLANT, DEPARTMENT OF PUBLIC WORKS, CITY AND COUNTY OF SAN FRANCISCO, CALIF.

THE Richmond–Sunset sewage treatment plant—in Golden Gate Park, San Francisco—handles combined sewage from a tributary population of about 150,000. Treatment processes include chlorination, sedimentation, and sludge digestion, elutriation, and vacuum filtration. Important features of plant design are described here by Mr. Benas, but of even more interest, perhaps, are the paragraphs in which he tells how the inevitable "kinks" have been ironed out in the first year of operation.

SAN FRANCISCO is mainly sewered by a combined system, and until recently all sewage was discharged untreated from a number of outlets along the shore. This resulted in undue pollution which had long been recognized, but it was not until 1933 that funds became available for complete studies and a definite program of treatment works construction.

In that year a board of consulting sanitary engineers consisting of the late Harrison P. Eddy, Charles Gilman Hyde, Clyde C. Kennedy, and Leon B. Reynolds (all members of the Society) was appointed to make the necessary studies and recommendations. In May 1935 this board reported substantially as follows: That the number of outlets discharging sanitary sewage in San Francisco Bay be reduced and that the sewage of the various districts be combined for treatment and disposal so that no untreated sewage might be discharged at any point along the bay or ocean fronts.

In order to accomplish this it was recommended (1) that sewage from the districts in the southeast portion of the city (see Fig. 1) be treated at plants located at Visitacion Valley and Hunters Point; (2) that sewage from the main portion of the easterly slope, comprising the North Point and Marina districts, be treated at a plant at North Point and discharged approximately 2,000 ft off shore in a 60-ft depth of water; (3) that a pumping plant and force main be constructed to convey the sewage from the Marina district to North Point; and (4) that the sewage from the westerly slope of the city, comprising the Baker's Beach, West Richmond, and Sunset districts, be conveyed to and treated at a plant in the southwest portion of Golden Gate Park. In regard to (4) it was also recommended that as much of the effluent as needed be furnished for use in the park, that the remainder be discharged into the existing Mile Rock trunk sewer to the present outlet on the north shore, and that the sludge be digested and dewatered on vacuum filters and furnished for use in the park, on municipal golf courses, and on other areas.

It was not possible under the 1933 sewer bond issue to complete the whole program, and as the north shore and Great Highway are the main recreational areas at present, attention was concentrated on their improvement. The Marina Pumping Plant and the discharge sewer leading to North Point were built, thereby eliminating the direct source of pollution at the Yacht Harbor. In addition, the federal government has constructed works to discharge the sewage from Fort Mason and the Presidio into the connecting sewers to the Marina Pumping Plant. Also built under the initial program were the Richmond–Sunset treatment plant, discussed in this paper, and the tunnel and connecting sewer leading to it

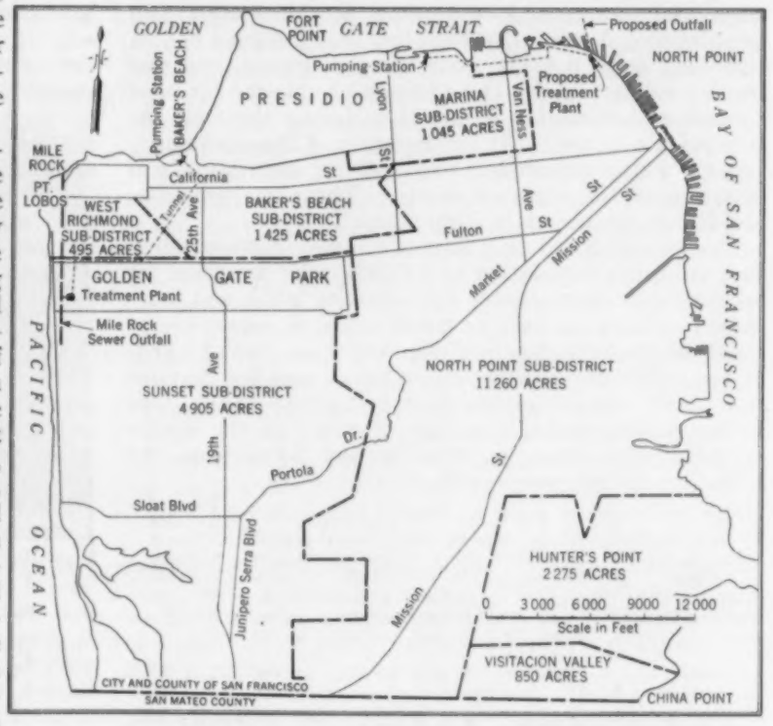


FIG. 1. CITY AND COUNTY OF SAN FRANCISCO, SHOWING SEWERAGE DISTRICTS AND PRINCIPAL EXISTING AND PROPOSED WORKS

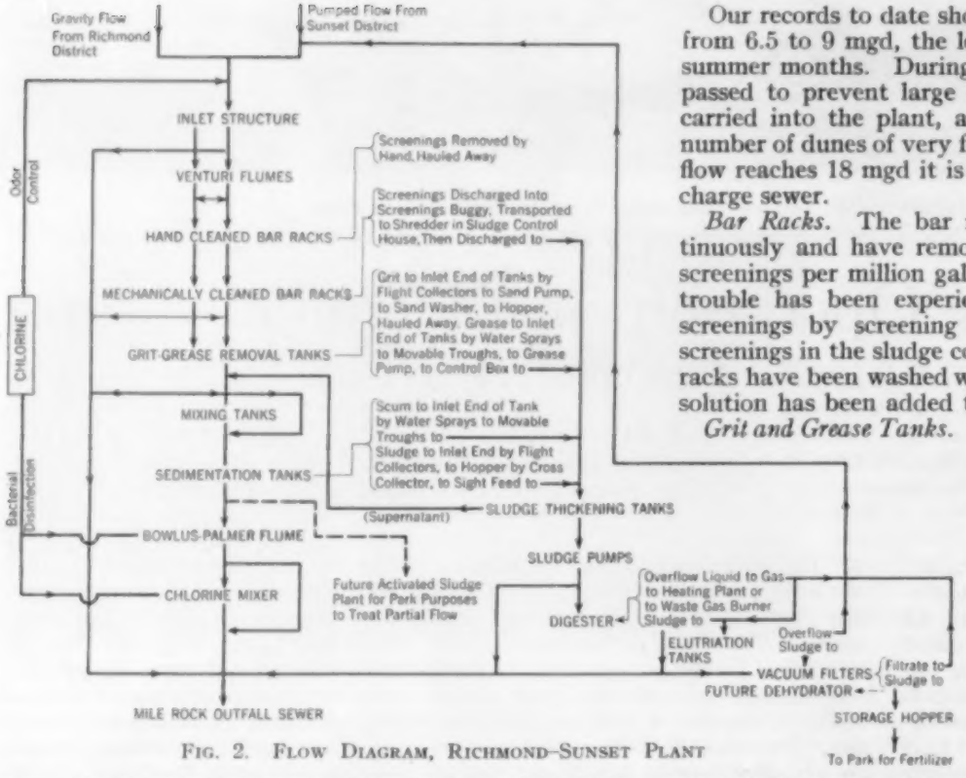

Gravity Flow From Richmond District
Pumped Flow From Sunset District
INLET STRUCTURE
Screenings Removed by Hand, Hauled Away
VENTURI FLUMES
Odor Control
Screenings Discharged into Screenings Buggy, Transported to Shredder in Sludge Control House, Then Discharged to
HAND CLEANED BAR RACKS
MECHANICALLY CLEANED BAR RACKS
Grit to Inlet End of Tanks by Flight Collectors to Sand Pump, to Sand Washer, to Hopper, Hauled Away. Grease to Inlet End of Tanks by Water Sprays to Movable Troughs, to Grease Pump, to Control Box to
CHLORINE
GRIT-GREASE REMOVAL TANKS
MIXING TANKS
Scum to Inlet End of Tank by Water Sprays to Movable Troughs to
Sludge to Inlet End by Flight Collectors, to Hopper by Cross Collector, to Sight Feed to
Bacterial Disinfection
SEDIMENTATION TANKS
(Supernatant)
SLUDGE THICKENING TANKS
BOWLUS-PALMER FLUME
SLUDGE PUMPS
Overflow Liquid to Gas to Heating Plant or to Waste Gas Burner
Sludge to
CHLORINE MIXER
Future Activated Sludge Plant for Park Purposes to Treat Partial Flow
DIGESTER
ELUTRIATION TANKS
Overflow Sludge to
VACUUM FILTERS
Filtrate to Sludge to
FUTURE DEHYDRATOR
STORAGE HOPPER
To Park for Fertilizer
MILE ROCK OUTFALL SEWER

FIG. 2. FLOW DIAGRAM, RICHMOND–SUNSET PLANT

from the Baker's Beach and West Richmond districts. These latter works eliminate the direct pollution caused by the discharge of untreated sewage at the Baker's Beach and Mile Rock outfalls.

Determination of the degree of treatment required at the Richmond–Sunset plant was based on discharging the effluent to the ocean and disposing of the digested sludge for use as fertilizer. In addition, special provisions were made necessary because of the location of the plant in a public park—architectural treatment for the structures, and odor control by housing, prechlorination, and ventilation. Accordingly the plant was designed (1) for removing large floating material, grit, grease, and suspended solids; (2) for the addition of chlorine for odor control and bacterial disinfection during the time the beaches are in use; (3) for digestion of the screenings, grease, scum, and sludge; and (4) for elutriation and filtration of the digested sludge. The plant processes and layout are shown in Figs. 2 and 3.

Design was based on a flow of 15 mgd, corresponding to a tributary population of 200,000, with provision for additional units to double this capacity when and if required. However, lack of funds made it impossible to build all the units to the design capacity, and two grit-grease tanks, two sedimentation tanks, and one digester were built instead of the four grit-grease tanks, four sedimentation tanks, and two digesters in the design layout. The areas, population, and flows from the tributary districts are as follows:

District	Area in Acres	Population 1930	Population Initial Design	Population Ultimate Design	Present Average Daily Sanitary Flow, MGD
Richmond	1,425	66,500	80,000	100,000	...
West Richmond	495	10,000	15,000	20,000	...
Sunset	4,905	70,000	105,000	190,000	...
Total	6,825	146,500	200,000	310,000	7.5

The treatment plant went into service in April 1939, and since completion of the preliminary trials in July 1939 all units have been in almost continuous operation.

Our records to date show that the average flow varies from 6.5 to 9 mgd, the lower flow occurring during the summer months. During storms the Sunset flow is by-passed to prevent large quantities of sand from being carried into the plant, as the Sunset area has a large number of dunes of very fine sand. When the Richmond flow reaches 18 mgd it is by-passed directly to the discharge sewer.

Bar Racks. The bar racks have been operated continuously and have removed approximately 3 cu ft of screenings per million gallons of sewage. No particular trouble has been experienced in the handling of the screenings by screening buggies or the shredding of screenings in the sludge control house. At times the bar racks have been washed with chlorine solution, and some solution has been added to screenings for odor control.

Grit and Grease Tanks. The sand brought to the plant by the tributary sewers is very fine, a large portion being between $^1/_{60}$ and $^1/_{100}$ mm in size. This sand would not deposit in a normal grit chamber with a velocity of 1 ft per sec, so it was necessary to design a grit tank that would allow lower velocities without deposition of undue quantities of organic material. Accordingly, Imhoff-type aerated tanks have been provided, having a holding time of 10 minutes at average flow. In these tanks the washed grit is deposited at the bottom and grease is collected in quiescent zones at the surface. The sand is scraped to the inlet end by flights, and pumped to a washer discharging into an elevated hopper and thence to a truck, while the grease is skimmed off by water sprays and pumped to the sludge control house.

The sand pump was originally installed with a 3-hp motor, this size being selected with a view to pumping a mixture of sand and water of approximately 75% moisture content at a velocity of approximately 4.5 ft per sec. However, some trouble was experienced in the plugging of the discharge line when slugs of sand got into the pump. The unit was therefore replaced with a pump having a 5-hp motor, so that velocities up to 7 and 8 ft per sec can now be obtained. No trouble has been experienced with the new installation.

The sand washer produces a reasonably clean and dry sand under normal operating conditions, the quantity varying from $^1/_2$ to 3 cu yd per day.

Tests were made of the air requirements and it was found that when air was applied at the rate of 0.05 cu ft per gal (based on the average flow) the maximum amount of sand was removed with a minimum of organic material. This rate was also satisfactory for grease removal, approximately 1,300 gal per day of grease solution being obtained.

Mixing and Sedimentation. Based on results of tests made previous to the design of the plant, mixers for slow stirring without the addition of chemicals were provided ahead of sedimentation. These tests showed that it was possible to obtain a considerably higher percentage removal of suspended solids with mixing than without, and that the settling curve became much steeper, so that it was not necessary to provide as long a detention period. At the Richmond–Sunset Plant the mixing tanks have a holding time of 30 minutes and the sedimentation tanks $1^1/_2$ hours at average flow.

The peripheral speed for the paddles was set at 1 ft per sec after tests made at the plant. Lower speeds result in

deposition and higher speeds in reduced removal of suspended solids.

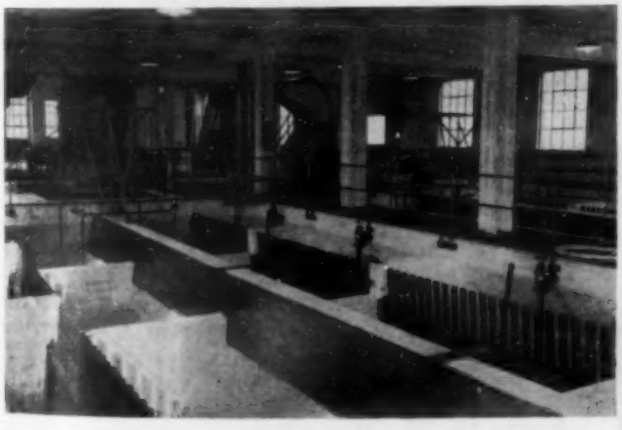
Our tests show that the over-all removal of suspended solids varies between 70 and 80% during normal operating conditions for a sewage with an average strength of approximately 350 ppm of suspended solids. This figure varies with the strength of the sewage and with the withdrawal of sludge from the sedimentation tanks. By continuously withdrawing sludge, thereby preventing any accumulation in the sedimentation tanks, it is possible to obtain an effluent of not over 50 ppm of suspended solids. However, such operation requires constant attention, so we have attempted to work out a withdrawal cycle based on the operator's average time.

Instead of carrying the scum to the discharge end of the sedimentation tanks by flights, water sprays using treated effluent are provided to carry the scum to the inlet end. This spray system works very satisfactorily and keeps the tanks in a clean condition at all times. Each sedimentation tank is provided with four effluent flumes, 25 ft long, with notched slots, giving a total equivalent weir length of 200 ft as against a tank width of 33 ft 6 in. This effluent weir length results in a slower rising velocity and in increased efficiency in removing suspended solids.

Sludge Control House. The sludge from the sedimentation tanks is withdrawn through sight feeds to sludge-thickening tanks, where some of the water separates from the sludge. The water is returned to the system ahead of the sedimentation tanks and the thickened sludge is pumped to the digester. Ground screenings and grease are added to the thickening tanks. It was found that a holding time of at least $1\frac{1}{2}$ hours was required for the sludge to thicken, and that with this holding time it was possible to obtain a sludge with approximately 95 to 95.5% moisture content.

No particular trouble has been experienced with odors in the sludge control house. Chlorine solution is added to the screenings before grinding, thereby eliminating the major portion of the odor from this source. No chlorine is added to the surface of the sludge in the thickening tanks.

Chlorination. Chlorine is added to the sewage before it reaches the plant, for odor control, and to the effluent,



PRETREATMENT BUILDING, SHOWING BAR RACKS, SAND HOPPER, AND GRIT-GREASE TANKS

for bacterial disinfection. Approximately 30 lb per million gal is required for prechlorination, while for post-chlorination the rate varies from 60 to 120 lb per million gal, the adjustments being made manually and the feed being automatic between adjustments. Frequent checks are made of chlorine residual and at times it is necessary to change the feed, depending upon the strength of the sewage. Post-chlorination has been used continuously except during times of storm or when the Sunset sewage was by-passed.

Sludge Digestion. It has been necessary to operate our one-unit digester, which was originally designed as part

SEDIMENTATION TANKS—NOTE SLOTTED EFFLUENT FLUMES AND SCRAPING MECHANISM

of a multi-stage digestion system, as a primary digester. This involves some complications, as it is not always possible to obtain a clear supernatant and heavy digested sludge. We have attempted to withdraw from the digester a quantity of digested sludge equivalent to the quantity of raw sludge added. This is determined by monthly checks of moisture content at various levels and by checks of the raw sludge pumped to, and the digested sludge removed from, the digester.

When operation was started, the digester was first filled with raw sewage, the temperature raised to 80 F, and the sludge added. Some lime was added with the original sludge. The pH of the digester dropped to 6.7, and when no further lime was added dropped to 5.3. As the pH did not increase, lime was added one month after the digester went into operation and the pH raised to 6.7. Since that time the digester has maintained a pH of approximately 6.9 to 7.1 without the addition of any more lime. Reduction of volatile matter in the digester since the third month of operation has been consistently between 50 and 60%.

The moisture content of the sludge in the digester at the top and at the bottom varies considerably, depending upon the temperature of the digester (normally carried at 90 F), the rate of gas production, the amount of withdrawal of digested sludge, and the rate of addition of incoming sludge. For an average condition the bottom sludge is approximately 96.5% moisture and the supernatant 99.6% moisture. We feel that if the second unit is built it will be possible to get stratification, a heavier digested sludge, and a clearer supernatant.

The amount of gas generated varies from approximately 90,000 to 160,000 cu ft per day, depending upon the rate of sludge addition, and averages about 0.9 to 1.0 cu ft per capita of connected population. Use of this gas in the boilers was begun as soon as its carbon dioxide content became less than 35%. It burns with a clear flame with practically no soot. To eliminate trouble with the operation of the gas meters due to accumulation of water, special traps and connections for draining have been installed.

Elutriation and Sludge Filtration. It has been determined that by washing out the soluble ammoniacal compounds, the amount of conditioning chemicals required for vacuum filtration can be kept at a minimum.

Accordingly, an elutriation system was installed. The treated effluent is used for wash water, and the dirty water is returned to the Sunset pumping plant to be recirculated through the treatment works.

We have made a number of studies on the proper operation of the elutriation and vacuum filter systems. When they first went into operation, considerable difficulty was caused by the return of the wash water to the plant. This water contained a high quantity of suspended solids which resulted in increased amounts of sludge deposited in the sedimentation tanks, more sludge pumped to the digester, a shorter digestion period, and undigested sludge. It was found that short-circuiting was occurring in the elutriation tanks. This has been eliminated by the construction of baffles, so that practically clear water is now being returned to the system. In addition to the digested sludge, the supernatant is also returned to the elutriation tanks.

At the present time it is necessary to add approximately 4% ferric chloride to sludge of approximately 96% moisture content, resulting in filtering rates of approximately 6 to 6½ lb of dry solids per square foot of filter area per hour on a filter of 200 sq ft net. It appears from laboratory tests that the consumption of chemicals can be reduced if some changes are made in the ferric chloride conditioning system, which would allow for very short mixing times and the discharge of mixed sludge directly to the filter vat. During the year both wool and cotton cloths were used on the vacuum filter, and it has been found that for conditions at this plant wool cloths have a much longer life.

Sunset Pumping Station. The flow from the Sunset District is diverted to the Sunset sump by a movable dam operated by an automatic gate-raising device in the Mile Rock sewer. In the design of the plant provision was made for a scraper in the sump to scrape the sand to a pit, and for a pump to convey the sand to a washer discharging onto a belt conveyor leading to a hopper. This installation was made with full knowledge that it might not be adequate and that additions and changes might have to be made.

The quantity of sand brought in by the Sunset sewage was so great—at times, after rains, approximately 20 cu yd per day—that the equipment did not function properly. Accordingly a new layout has been made which embodies, in addition, provision for carrying the sand to the scraper, agitation of the sand in the sump, and a pump to maintain velocities of at least 8 ft per sec. With this installation it is possible to handle the sand satisfactorily without having to shut down the sump for periodic cleaning. It is frequently necessary, however, to lower the level in the sump and use the incoming sewage to flush the sand to the trough.

The sand scraper was originally equipped with steel flights traveling along rails set in the concrete at the base of the cross trough. After about six months of operation it was noted that the concrete was worn on each side of the rails and that the rails had cut slots in the flights. New steel flights were accordingly made with adjustable pure gum rubber inserts, so that now the rubber is traveling on the rail. No further trouble has been experienced. Flights of the same design have been installed on the sand-collecting mechanism in the grit-grease tanks.

Laboratory. The function of the laboratory is threefold: (1) to obtain data on plant operation for record and control, (2) to attempt to improve the operation of each unit for maximum efficiency, and (3) to do such research work as is necessary for information on the design of future additions to the plant and for any new plants that may be constructed.

Daily tests are made of the strength of the raw sewage and plant effluent in suspended solids; percentage moisture and volatile matter of sludge pumped to the digester; pH; percentage moisture and volatile matter of sludge at the top and bottom of the digester; strength of ferric chloride used as a sludge conditioner; and percentage moisture and volatile matter of the elutriated and filtered sludge. In addition, analyses are made periodically of the sludge gas, of the chlorine demands and residuals, of grease content, and of the B.O.D. of the raw sewage and final effluent. Plant operation is adjusted in accordance with the results obtained.

Simple tests have been devised wherever possible to assist the personnel in the operation of the various processes. For instance, the control of the ferric chloride feed for conditioning the sludge passing to the vacuum filter is by a vacuum break test which is made by the filter operator.

The correctness of the laboratory results obtained is of course limited by the degree to which the samples are representative. A special effort has been made to devise sampling schedules such that the best representative samples will be obtained without undue interference with other duties of the attendants.

We feel that operating results to date have been satisfactory, and substantially in accordance with the design.

The plant is under the direction of the writer as superintendent, K. Fraschina, assistant superintendent and technician, and R. R. Sotter, chief operating engineer; and under the general direction of A. D. Wilder, M. Am. Soc. C.E., director of public works, and John J. Casey, M. Am. Soc. C.E., city engineer.

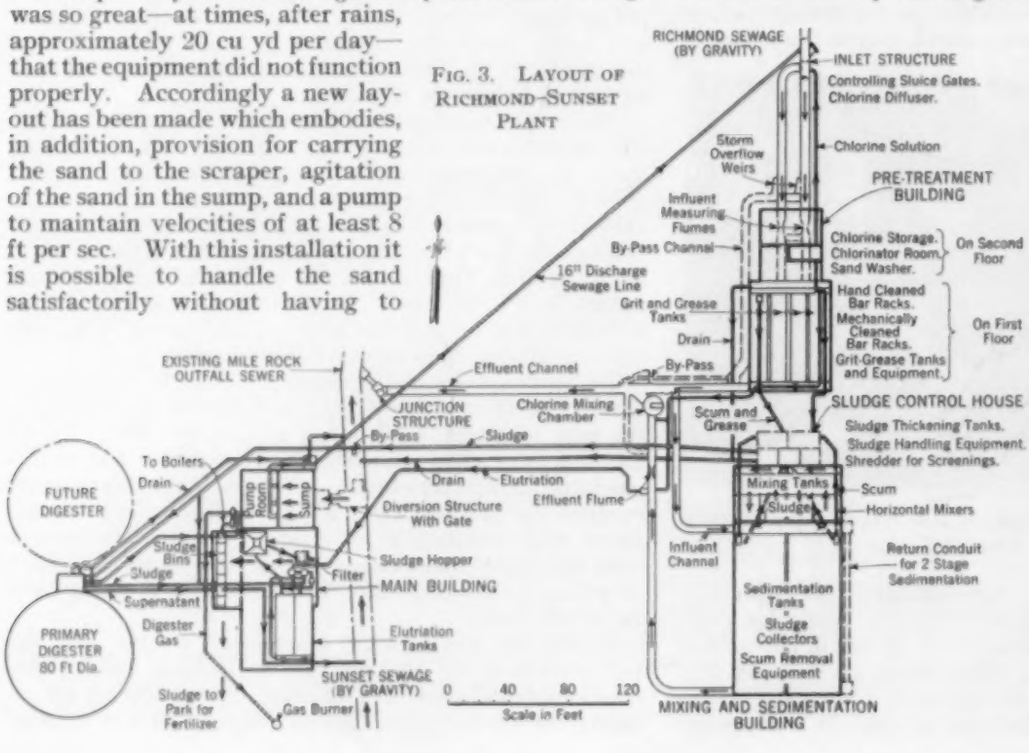


FIG. 3. LAYOUT OF RICHMOND–SUNSET PLANT

Traffic Channelization Methods

The Application of General Principles to Specific Cases

By Guy Kelcey

Member American Society of Civil Engineers
Signal Service Corporation, Elizabeth, N.J.

As background for the present article the reader may wish to consult "Channelization of Motor Traffic," in the December 1939 issue of "Proceedings." There Mr. Kelcey discussed factors governing the behavior of drivers and outlined principles of traffic flow that combine to explain and to provide a basis for the solution of certain traffic problems. Here he goes on to outline ways in which driver-behavior factors and various physical principles may be employed to effect workable solutions.

THE shortest time between two points requires uninterrupted motion. Thus a driver will normally reach his goal faster at a uniform moderate speed, continuously maintained, than by an interrupted, high-speed "dash—slow down—dash—stop—dash" progression. Uniform continuity of motion, upon which greatest efficiency of traffic flow depends, requires order. Safety also is corollary to and dependent upon order. The establishment of conditions to this end, and to which drivers will respond naturally, is the primary purpose of channelization.

Major objectives of channelization would be satisfied if all conflicting movements of traffic were separated, horizontally and vertically, or both, by a system of one-way roadways which underpass and overpass or merge, under favorable circumstances, at points of intersection. Since this is impossible of extensive attainment, channelization aims to make the most of the situation. It employs a variety of means to separate opposing flows of vehicles, to simplify and reduce conflicting movements, and to confine such movements to the smallest possible areas of conflict.

Otto Jelinek, Traffic Engineer, Chicago

"Barrier Aspect" Added to White-Line Treatment

Rubber flaps equipped with spring-steel strips produce a disconcerting staccato by striking sharply on the axles of over-riding cars.

Channelization methods are equally applicable to older roadways and to new designs. The benefits to be gained along older roadways, even though sometimes short of the maximum desired, are nevertheless substantial and should not be overlooked.

Instrumentalities of Channelization

Having determined upon the best organization of traffic flow (See "Channelization of Motor Traffic," Proceedings, American Society of Civil Engineers, December 1939), means must be applied to make the plan effective and particularly to limit straying of adventuring drivers. Success depends upon adherence to a number of traffic principles. Of particular importance is the fact that drivers choose natural, easy paths and avoid those that appear difficult. Therefore right courses must be made easy and wrong ones hard, or to appear hard. Desired results are then automatic.

Right courses are channeled and made easy and wrong ones blocked and made uninviting by the use of islands, dividing strips, fins, curbs, and other means of separation. At one end of the list is the painted line and at the other are the physical barriers that partially or wholly obstruct wrong movements.

The effect of a barrier may be in its physical character, its annoyance or illusion value, or in the motorist's fear of accident or punishment, or a combination of these. A low curbing or other treatment that bars vehicles at high speeds may be ineffective at low speeds. However produced, barrier effect must be positive in safeguarding drivers and keeping them in their own proper lanes.

Painted lines and areas, while useful for many purposes are not wholly satisfactory channelizing means unless quite strictly enforced. Paint must usually be supplemented by fear of punishment because it has no physical, and only limited moral, restraining influence. Painted lines and areas are, however, useful in supplementing other channelizing means.

Curbs, ranging from low-lipped or sloping designs to more vertical types, are usually employed to establish island and separator strips. These separator curbs or areas should present maximum color contrast to the adjacent pavement to insure the greatest possible visibility.

The barrier effect of low sloped curbing can be secured through the use of cast markers about 3 in. high and 18 in. in diameter, painted white or aluminum for visibility. They are effective in confining vehicles in proper lanes, but if run over they do not deflect a vehicle and the bumping effect is slight. Such markers are used to test planned treatments and are often, as in Washington, D.C., left in place for long periods.

One type of island, made with paving block or brick, in conspicuous color contrast to surrounding pavement, starts at pavement level and rises gradually to a height of 6 in. or more at the center. The rise may also be in irregular steps to give the appearance of rough cobble. The resulting barrier aspect, due to color difference and rough surface, is effective. The National Park Service employs this type of island with a smooth surface in the

Cast Markers May Be Used on Either Street or Highway

These 18-in. diameter markers are held in place by a tar core which also provides uniform bearing. When properly spaced, they present an excellent barrier aspect without being dangerous.

Tom Seburn, City Traffic Engineer, Kansas City, Mo.

BRIDGE PIER WITH DEFLECTOR-INTERCEPTOR TYPE PROW

A structure like this (see text) does little or no harm to motorists who strike it, glancing or full on, at speeds as high as 45 miles per hour. Note black and white striping, which provides a concept of proportion and dimension by which drivers may judge distance.

entrances to the driveway around Lincoln Memorial, Washington, D.C.

On U.S. Highway 50 S, in Kansas, concrete bars, 2 in. high by 4 in. wide by 24 in. long, placed crosswise and 4 ft apart along the center line, have been found effective. These bars produce a staccato sound when run over and are disconcerting but not dangerous. While they permit passing, they divide opposing flows effectively along this and some other high-speed highways.

Dividing islands on some parkways in New York City and in Westchester County, N.Y., and on the Merritt Parkway in Conn., employ low curbing and low-growing shrubs or vines which rise to a height of 18 to 24 in. This treatment has a good barrier aspect. Higher shrubs and bushes, on center islands that are wide enough, beautify the highway, provide both the aspect and the value of a substantial barrier, and reduce or eliminate opposing headlight glare. Other methods range from narrow divisional fins to landscaped islands 50 ft or more wide. Where necessary land is available, designs are dictated solely by traffic needs, while limited rights of way require compromises.

To channelize roadways of limited width requires the use of quite narrow fins or special separator devices with quite positive barrier value. On many of these roadways a single collision of two vehicles moving in opposite directions at a time of peak load would result not only in a succession of accidents but in a traffic jam that would spread out in all directions from the focal point. Some of the special means of separation employed are quite novel. The Chicago Park District's cable-type divider is flexible, is reported not to throw colliding cars out of control, and aids drainage. Another similar treatment employs guard-rail plates placed back to back. One section of Chicago's Outer Drive is equipped with fins that are raised or lowered to adjust roadway width to favor directional movements under conditions of heavy flow (Fig. 1). This treatment essentially provides two more lanes, for which demand exists but for which additional land cannot possibly be secured.

The Chicago Park District reports a 19% decrease in accidents following installation of various types of divisional fins and islands on several boulevards, and that while previously 18% of the accidents involved opposing movements, none of this type occurred after the separator installations were made.

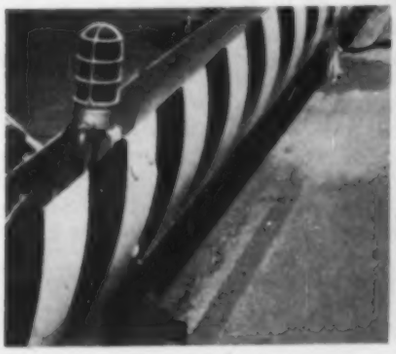
Over 400 traffic islands, installed during the past ten years in Milwaukee, have improved traffic flow. Accident conditions have bettered progressively as the number of islands has increased.

Channelizing means are available for all types of highways, ranging from unimportant roads to the most densely loaded traffic arteries. Some of these means are useful and effective and some are not. Some work well under certain conditions but not under others. If such means definitely limit traffic to its proper channels, they are useful; if not, they have little or no value and often do harm by creating the illusion of a safeguard which has no substance. Selection of the best channelizing means for a particular purpose requires consideration of many factors ranging from driver psychology, speed and traffic conditions, to physical factors of the location. There are few ready-made answers, so the treatment must be thought out in terms of the problem at hand.

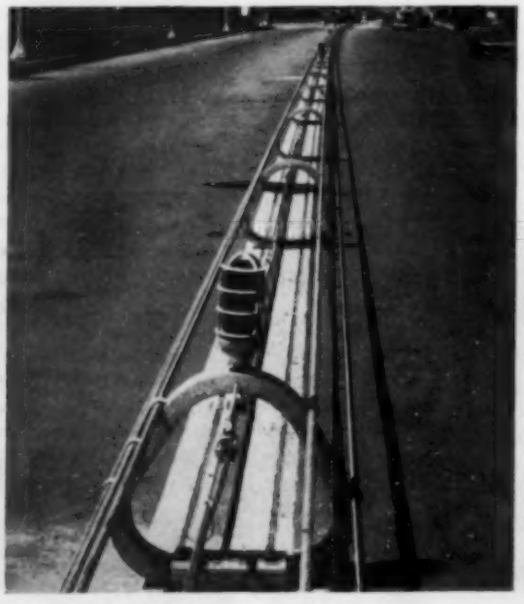
DESIGN OF TRAFFIC ISLANDS

A traffic island, dividing strip, or other channelizing means, when it is correctly designed and located, acts as an aid rather than an interference or obstruction to traffic that is moving properly.

There are two general types of channelizing means. One discourages, to varying degrees, but does not absolutely restrain, vehicles tending to get out of their proper channels. The other protects persons, property, structures, or other traffic in areas from which vehicles must



U.S. Spring and Bumper Co., Los Angeles



Otto Jolinek, Traffic Engineer, Chicago Park District

Miller McClintock Traffic Research Bur., Yale Univ.

VARIOUS TYPES OF DIVIDER FOR HEAVILY TRAVELED HIGHWAYS

At the left is shown the barrier (guard-rail plates, back to back) used on Romona Boulevard, Los Angeles. Traffic Engineer R. T. Dorsey lists advantages as including minimum space requirements, good drainage, and that striking vehicles are not likely to be thrown out of control. In the center is the cable separator developed by the Chicago Park District and used on Leif Erickson Drive. Note the effective use of the painted lines to aid visibility with this successful treatment. At the right is an economical parabolic-typed divider or deflecter which takes up little road width. It restrains and redirects vehicles that move out of channel, without injury to car or occupants. Only the tires contact the separator, which acts like a superelevation in the road itself, and it does not cause drivers in adjacent lanes to shy away.

definitely be excluded. Properly designed barriers of the first type do little or no harm to drivers who run over them. Barriers of the second type, however, are absolute and present a limit-of-passage obstacle. It is easy to conclude that drivers who collide with such major barriers, properly designed, placed, and safeguarded, are drunk, careless, or reckless—and about all such drivers are—but if it is possible to protect them as well as the persons and property exposed to the consequences of their bad driving, it must be done.

Whether the channelizing means involves a minor or major barrier, the intended exclusion must be accomplished if possible by avoiding damage by or to the barrier; or if this cannot be done the consequences of collisions must be minimized so that the least possible injury is caused.

Possibility of damage from or to vehicles is reduced by proper location of the barrier and arrangement of the approaches. After this, the design of the traffic approach end of the structure becomes of paramount importance.

When cars approach an object or a hole in the roadway they swing out to avoid it. On the traffic approach end, the area of unused pavement with few wheel marks has gradually curving sides, and will increase in length with the speed of traffic. Traffic approach ends of exposed islands, parkway strips, and other similar installations should be shaped to conform to this natural sweep of vehicles. Then a driver who misjudges his leeway or is forced into an island, will strike its naturally curved sides a glancing blow and be deflected with little or no damage and without losing control. Approach ends are sloped on the right side when cars pass only to the right, or on both sides if cars operate also to the left.

An interesting design for safety zones was first used in Kansas City, Mo., by Tom Seburn, the city's traffic engineer. This design (conceived by Miller McClintock, director, and Theodore Matson, research associate, Traffic Research Bureau, Yale University) provides means by which a colliding vehicle, when not deflected, is intercepted and stopped with little or no damage up to speeds, it is claimed, of 45 miles an hour, and with reduced damage at higher speeds. This is accomplished by providing, in addition to gradually curved sides by which vehicles are normally deflected, an inclined end or prow on which the front axle of a vehicle rides up the gradual slope and, by frictional resistance, reduces the speed to or approaching zero before impact with a buffer or abutment. The fireman's net into which one may leap to safety from a height illustrates how quickly and smoothly, and in how short a distance, the energy of even a fast-moving vehicle can also be absorbed.

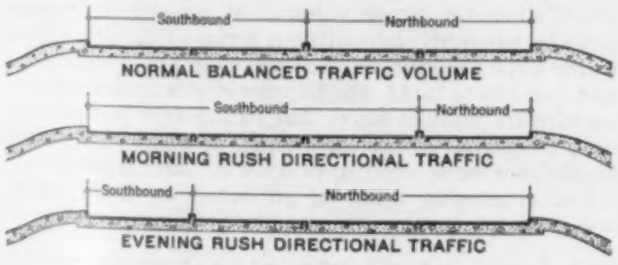


FIG. 1. CAPACITY-PROVIDING DIVISIONAL FINS

These hydraulically operated, remote-control fins are under trial on a section of Chicago's Lake Shore Drive which is seriously overloaded by an alternating directional flow and which cannot be widened. They are expected to add the equivalent of two lanes of extra capacity. At similar locations stop-and-go signals are sometimes used, one above each lane. However, a single head-on collision may tie up everything in rush hours. The hydraulic dividers, which provide a barrier between opposing flows, eliminate such difficulties.

M. W. Taylor, City Engineer, New Brunswick, N. J.

A SMALL TRAFFIC CIRCLE WITH DEFLECTOR ISLANDS

Here heavy local traffic and the commuting rush to and from the New Brunswick (N.J.) station are distributed.

Sixty-three of these "deflector-interceptor" type approach ends have been installed on street-car loading zones and to safeguard piers and abutments in the roadways of Kansas City. Eleven others are used by the Missouri Highway Department around the city to protect piers and bridge abutments. Since the first installation in 1931, a number of vehicles have straddled and ridden up the interceptor prows, some at fairly high speed. Usually slight or no actual damage resulted. One fatal accident occurred to a driver, going at an estimated speed of 70 miles an hour in daylight—but under other conditions he would have done much greater damage. Many fatalities and injuries to persons protected by the islands were prevented by these prows.

It is necessary to safeguard traffic islands and other structures in pavement areas by making them clearly visible to approaching drivers, both in daylight and at night, from such distances that there will be no confusion or difficulty. This is not enough, however. All traffic signals and signs, and particularly treatments by which traffic islands are safeguarded, must be designed with due regard for optical illusion, which is an unsuspected but major cause of many accidents. When observed after dark, many objects, such as lights, signals, signs, traffic islands, and dividing strips, may give drivers the illusion of false distances. Judgment of distance requires the observer to estimate the dimensions and proportions of objects ahead. Therefore it is necessary that lights or other markings, by which an island or obstruction is safeguarded, be of a known and easily recognized size or spacing, or that they illuminate and define something of known proportions. Otherwise distance cannot be judged definitely, and the estimates of different observers as to the distance to a given object will differ widely. Many channelizing treatments invite accidents because the problem of optical illusion is overlooked or ignored, causing drivers to misjudge distances. Painted lines which swing gradually around a traffic island or an obstruction in the roadway, so that traffic is swept clear, aid in correcting these illusions.

TREATMENT OF NARROW ROADWAYS TO ACCOMMODATE TURNING MOVEMENTS

Vehicles entering an intersection, past an island, need only a normal width of lane. However, vehicles turning left or right out of an intersection of narrow roadways, past an island, need more room, and to favor them channelizing islands in narrow roadways should be offset. (Note island *X* and vehicles *A*, *B*, and *C*, Fig. 2.) When

New Jersey State Highway Department

DISTRIBUTING 60,000 TO 80,000 CARS A DAY

This is the junction of U.S. 1 and 22 and N.J. 21, 25, and 29. Distribution is accomplished smoothly and safely by overpassing westbound U.S. 1, by carrying eastbound traffic at grade, and by carrying and distributing the additional heavy load by traffic circle. Note the long merging distances between entrance and exit points; also the combined use of grade separation and circle—that is, of horizontal and vertical distribution.

the intersected roadway is also narrow, an island placed on its curb line may too greatly limit the radius of left-turn movements of vehicles both leaving and entering the intersection. Longer turning radii may be provided by moving the island back the needed extra distance from the curb line. (See island *Y* and vehicle *D*, Fig. 2.) Thus by offsetting, to favor vehicles leaving the intersection, and dropping back, if necessary, to accommodate left-turning vehicles both leaving and entering, handicaps of limited roadway width are overcome. Under some traffic conditions, in built-up communities, channelizing islands will be found helpful where intersecting roadways are as narrow as 30 ft. Parking limitations must be imposed to suit needs of the installation. It is desirable, of course, that one of the intersecting roadways, and if possible both, be wider than this, although some useful island installations have been made in roadways of even less width.

Offsetting of traffic islands is done for a number of other reasons also. Along Michigan Boulevard in Chicago, many of the islands upon which the stop-and-go signals are installed, and which safeguard pedestrians halfway across this heavily loaded artery, are offset to the right to shield left-turn movements. This sets up a center lane in each direction as a reservoir for storage of left-turning cars which move with the cross flow.

In some cases, as in Milwaukee, traffic islands stop short of the curb line, not only to increase turning radius but to provide pedestrians and baby carriages with a choice between a pavement-level refuge or a platform end, extending halfway into the sidewalk zone, upon which they may stand in sloppy weather.

MERGING TRAFFIC

When vehicles moving in the same direction in adjacent lanes converge into a single lane, they are said to merge. Merging is accomplished with greatest efficiency and least confusion or turbulence when converging angles are relatively flat and relative speeds approximately equal. On high-speed or heavily loaded roadways, therefore, acceleration lanes are desirable on which entering vehicles may be shielded from the main flow until ready to merge with it. Short acceleration lanes are helpful, but if possible such lanes should be long enough to permit merging drivers easily to attain the speed of the main flow. By converging on a flat angle, through a sufficient distance, they can see the main-flow vehicles and exercise accurate judgments in merging with them at the proper moment. For vehicles departing from a main movement, deceleration lanes must often be provided so that, without interference to the main flow, drivers may drop out and slow down to speeds necessary for executing turn-off maneuvers.

Length requirements for acceleration and deceleration lanes vary both on tangents and on circles. They depend upon front and rear sight distances, normal speeds and differences of speed, and physical conditions. Lengths of 350 ft or more are desirable although much shorter distances may be and are used. The Pennsylvania Turnpike, designed for high speed, has acceleration and deceleration lanes 1,200 ft long for easy merging and for deceleration, at exits, on engine compression, without the use of brakes.

To encourage proper use of such lanes, their pavement should, where possible, contrast in color with the adjacent main roadway. On tangents, this makes these lanes uninviting to the faster moving drivers on the main roadway, for whom they are not intended.

This principle of acceleration and deceleration lanes is applied to traffic circles by extending the deflector islands into the area of the circle to a depth of from half to a full lane, thus shielding entering and departing movements.

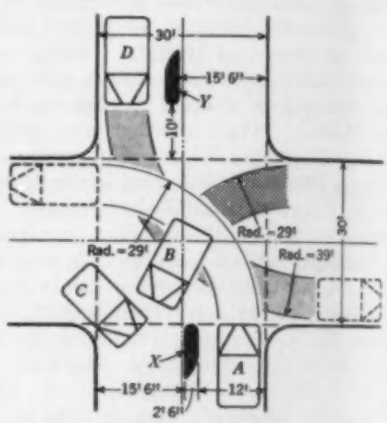


FIG. 2. ILLUSTRATING OFFSET AND SETBACK OF DIVIDING STRIPS

The problem of interchange of vehicles proceeding around a traffic circle, between entrance and discharge points, is essentially the same as that of vehicles merging and discharging into and out of a main flow on a tangent. The interchange is accomplished with least turbulence when space enough is provided between entrance and exit points so that vehicles converge at relatively flat angles and interchange at approximately the same speeds. It has been demonstrated, however, that even when interchange distances are quite short, as in many circles now in use with less than 300-ft diameter to center of roadway—and in some low-speed circles with less than 100-ft diameter—large volumes of vehicles interchange quickly, smoothly, and without serious difficulty. Since traffic circles require less acreage than grade separations and cost less to build, much larger circles than are now in use may be justified where they eliminate or postpone the need for partial or full separation, or where enough land should now be secured to provide for later separation.

For interesting material published on traffic circles and grade separations the reader is referred to:

Marsh, Burton W. "Planning Highway and Street Intersections for Modern Traffic Needs," *Municipal Index*, 1931.

Griffin, Harold. "Highway Separations and Other Special Intersections," *Proceedings*, Association of Highway Officials of the North Atlantic States, 1932.

Swan, Herbert S. "Traffic Circles and Rotary Traffic," *Civil Engineering*, July 1932.

Swan, Herbert S. "Separating Grades at Highway Intersections," *Civil Engineering*, February 1933.

Malcher, Fritz. "Steady Flow Traffic System," Harvard City Planning Studies, Vol. IX, 1935.

Report of Committee on Street Traffic, to American Transit Operating Association, American Transit Association, 1936.

The Application of Soil Mechanics in Building the New York World's Fair

By GEORGE L. FREEMAN, M. AM. SOC. C.E., GEORGE W. GLICK, *and* HAMILTON GRAY, JUN. AM. SOC. C.E.

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THE job of founding the "World of Tomorrow" on an ash dump provided a notable opportunity for the young science of soil mechanics to demonstrate its practical aspects. Field tests, laboratory studies, and mathematical analyses of soil behavior all had a part in determining the fill-placing methods, the permissible loadings, and the foundation designs suitable for the difficult conditions encountered. The authors here review a number of the problems involved in the work, and the solutions developed.

RECLAIMING Flushing Meadow for a World's Fair site, to be subsequently converted into a New York City park, afforded an unusual opportunity for soil study and the application of soil mechanics. Descriptions of the Meadow, the engineering investigations that preceded its development, and the work of reclamation and grading have previously appeared in other publications and need not be repeated here.

Exploratory borings disclosed that the original surface is underlain by a deep layer of organic silt and clay of high water content, deposited on a trough-shaped floor of sand and gravel extending under the entire area of the meadow, and dipping downward from the edge of the marsh to a depth of around 70 ft at the center, along the north-south axis. Borings in the area between Horace Harding Boulevard and the Long Island Railroad (see Fig. 1 for location), used for 30 years as a city dump, showed that the accumulated weight of ashes and rubbish had forced the meadow surface 20 to 30 ft below its natural level, the total depth of dump at one point being 125 ft.

A survey of existing structures on the Meadow showed that the most frequent cause of trouble was the failure to drive supporting piles to proper penetration in the underlying sand, while another was soil movement induced by filling or grading operations with resulting lateral displacement of structures whether or not supporting piles were properly driven into the sand. Where filling operations had preceded pile driving, and the piling had properly penetrated the underlying sand, little difficulty had been experienced.

Consolidation tests of soil samples, made at Columbia University, indicated but little pre-consolidation of the soil in either the filled or unfilled portions of the marsh, the moisture contents being higher than would be anticipated from the weight of the overburden.

Much study was devoted to methods of grading the site, as consolidation tests on remolded samples indicated that, if disturbed, the natural soil structure would be destroyed, and settlement might be increased several fold. Past experience had shown that such disturbance could easily occur, since the placing of heavy fills had often created mud waves extending many feet from the fill. Bridge approach fills, with conventional earth slopes, had broken while, or shortly after, being placed; in one instance such a fill had broken progressively in three circular slides and created disturbance for a distance of over 500 ft. It was particularly important to prevent disturbance of the subsoil and excessive settlements, as the amount of borrow available in the old dump was barely sufficient to bring the low areas to minimum desired levels.

To solve problems of ground stability, recourse was had to the works of Dr. L. Jurgenson, in which he relates the depth of fill, or surcharge load, to the shearing strength of the soil. (See "The Application of Theories of Elasticity and Plasticity to Foundation Problems," *Journal of the Boston Society of Civil Engineers*, Vol. XXI, No. 3, July 1934, and "Stability of Earth and Foundation Works and of Natural Slopes," *Proceedings International Conference on Soil Mechanics and Foundation Engineering*, 1936, Vol. 2, page 194.) The average of 15 shear tests indicated the shearing strength of the soil to be about 120 lb per sq ft, representing the maximum shearing stress produced by a fill of 4.7 ft of material weighing 80 lb per cu ft.

Two field loading tests were made on the marsh, one on a 25-ft diameter circular area, and the other on a 50-ft square. In the first test, settlements and lateral movements were observed as ash fill was placed in 1-ft layers. There was no lateral movement until the depth of fill was increased from 4 to 5 ft, after which definite lateral and upward movements outside the loaded area were noted and the test was stopped. In the second

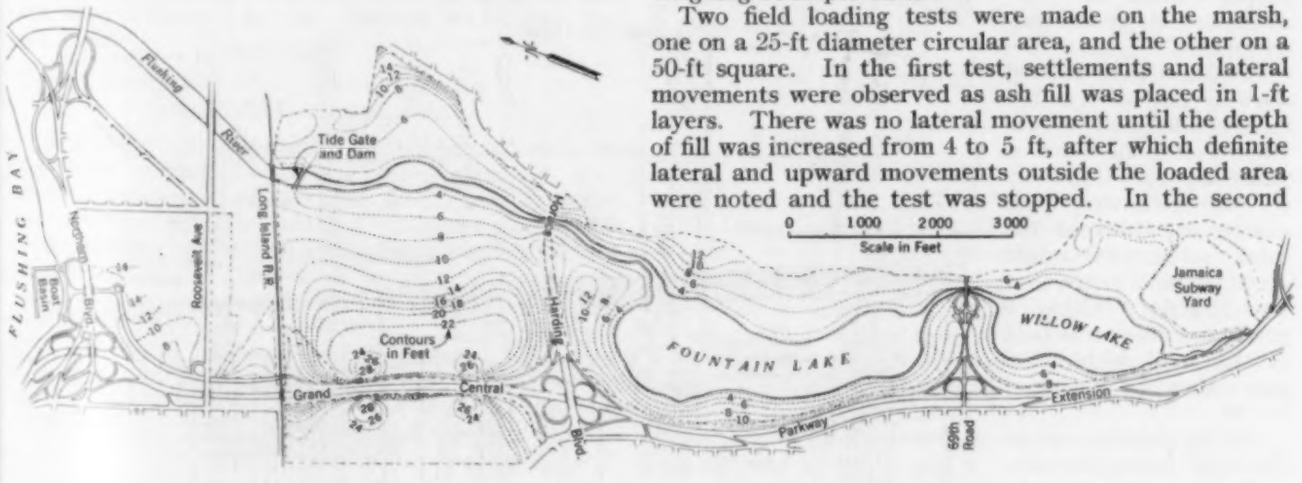

FIG. 1. GRADING PLAN OF FLUSHING MEADOW PARK, SHOWING FINAL CONTOURS, IN FEET, ABOVE QUEENSBOROUGH DATUM

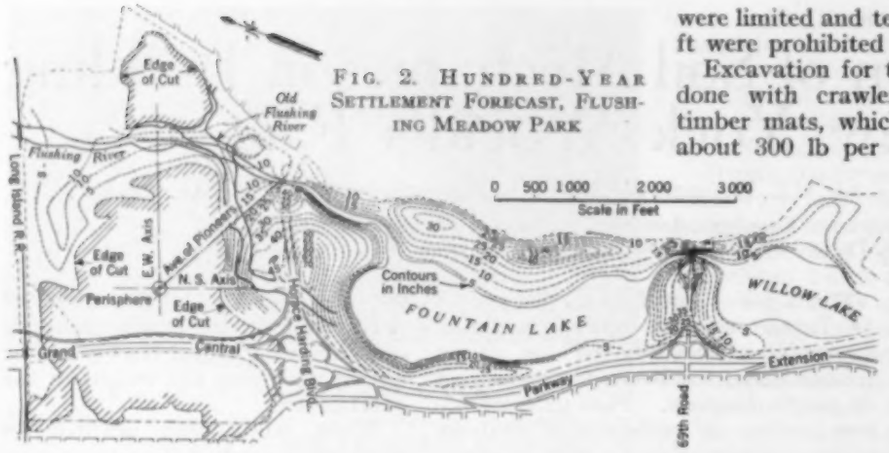

FIG. 2. HUNDRED-YEAR SETTLEMENT FORECAST, FLUSHING MEADOW PARK

test, ash was dumped on the area from trucks and pushed into place by bulldozers, and stakes located 50 to 100 ft from the edge of the fill showed lateral movements when the depth of fill was increased from 4 to 8 ft. These field tests generally confirmed the findings from the laboratory tests and computations.

The maximum permissible loading on the natural marsh was estimated at 375 lb per sq ft. To determine maximum safe slopes for embankments, Jurgenson's solution for terraced slopes was used, assuming the slope to be of infinite extent, and a maximum grade of 3.0% was determined and adhered to in the grading operations. Fill was placed in layers not over 4 ft deep, and where a second layer followed a first, its face was kept 100 ft behind the first.

The material in the dump proved entirely suitable for fill, and its relatively light weight was desirable to reduce settlement and minimize the volume of fill required. The weight of the ashes showed a range from 56 lb per cu ft damp loose to 111 lb in a compact saturated condition, an average of 80 lb being used in the computations.

Following the decision to proceed with the New York World's Fair, new areas north of the Long Island Railroad were added to the site, increasing the total to over 1,200 acres and requiring 6,200,000 cu yd of fill. Grading plans of the cut area were adjusted to make available the necessary volume of fill (Fig. 1). Settlement forecasts, based on the established grades, were made, and the contract grades were raised to compensate for estimated settlements where necessary to assure proper surface drainage and keep roots of trees and shrubbery above groundwater level.

Contours were plotted showing estimated settlement of filled areas at two, twenty, and one hundred years (Fig. 2). Generally it was estimated that nearly one-third of the total settlement would occur within 2 years, over two-thirds within 20 years, and the greater part of the total within 100 years after the placing of the fill.

During grading operations the limitations prescribed by the engineers were generally observed. Weights of loaded trucks were limited and temporary loads of over 300 lb per sq ft were prohibited on marsh and on newly placed fill.

Excavation for the lakes and new river channel was done with crawler-tread draglines working on large timber mats, which limited the load on the marsh to about 300 lb per sq ft. It was difficult to maintain bank slopes for the new stream channel, and breaks occasionally occurred. Filling the old stream channels, by any practical method, usually induced a wave of soft material in the river bottom ahead of the fill. In one case a mud wave developed in the old river channel following the placing of about 4 ft of fill along the river edge, the ground movement extending 200 to 300 ft landward from the side of the river. Such failures generally resulted in soil disturbances extending a distance equal to 10 times the height of the bank from its edge.

PERMANENT STRUCTURES

Permanent stream channel bulkheads, bridges, tide gate and dam, and a boat basin were built by the State or City of New York. At each site dry sample and undisturbed sample borings were made, and geological profiles plotted to show subsurface conditions. Undisturbed samples were forwarded to the Columbia University soil mechanics laboratory for tests.

The stream channel bulkheads, designed to confine and permanently fix the new river channel where it passes under 69th Road and Horace Harding Boulevard bridges, are of steel sheet-pile construction. Each bulkhead is about 400 ft in length. The sheet piling derives its lateral support from the sand below the silt and clay, and from a plank floor with transverse timber struts spaced at 5-ft 6-in. centers along the channel bottom. The bulkheads are braced against lateral movement by lines of outwardly battered piles.

For bridges constructed in the marsh area, approach grades and fill slopes were limited to 3%, except where old fill provided firm supporting soil. (The Horace Harding Boulevard Bridge is shown in Fig. 3.) Hollow, unfilled abutments were used to reduce the height of approach fills that were placed prior to the installation of foundations. Bridge foundations, except for the approaches, are of concrete-capped, untreated timber piles, cut off at lake level. For the approaches, creosoted

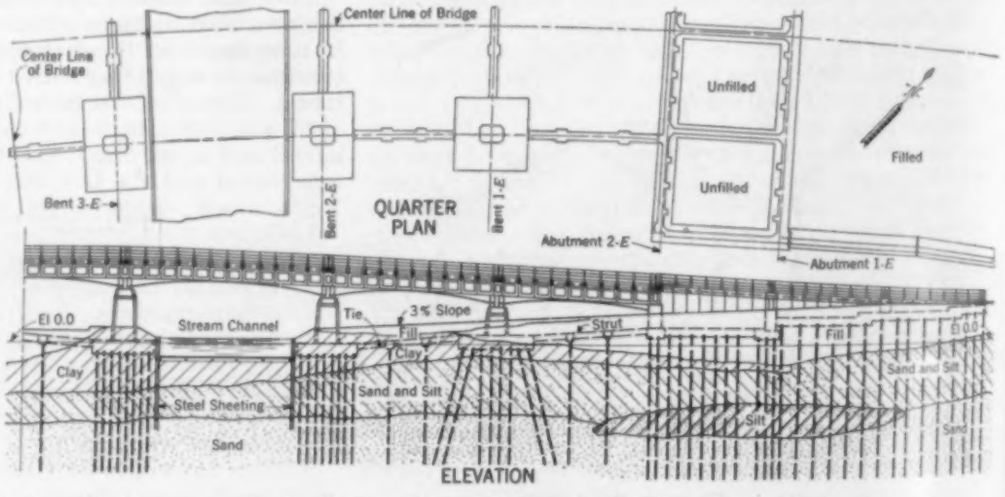

FIG. 3. ELEVATION AND QUARTER PLAN OF HORACE HARDING BOULEVARD BRIDGE

timber piles, cut off above ground-water level, were used. All pile caps are tied in two directions with reinforced concrete struts. Timber piles have 7-in. points and are loaded to a maximum of 18 tons, including the weight of pile caps and earth fill above them and frictional drag due to subsoil consolidation. Batter piles were used to transmit lateral forces to the sand.

At the Boat Basin on Flushing Bay a sand-filled, cellular, steel sheet-pile bulkhead was used, designed as a

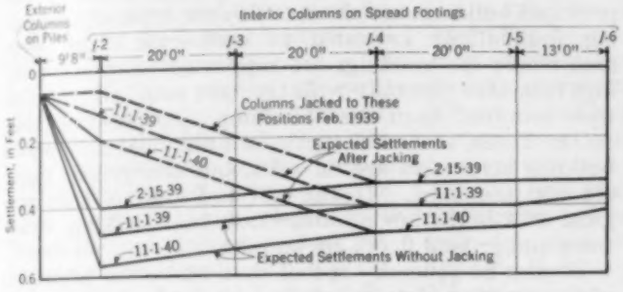

FIG. 4. SETTLEMENTS OF COLUMNS IN NORTH WING OF ADMINISTRATION BUILDING

cantilever to resist the difference in forces on the land and water sides. The low shearing strength of the natural soil necessitated removing the soil from within the cells and replacing it with sand.

The dam, with its hinged tide gates, maintains the lake levels throughout the Fair area and prevents the passage of salt water. It is essentially a cellular steel sheet-pile structure similar to the Boat Basin bulkhead, with the superstructure, including the bridge, piers, and apron, carried on piles battered both upstream and downstream to resist the lateral forces due to the shifting of the tide. The cell construction was extended into the banks to support the approach fills, and increase the path of flow around the ends of the structure.

Approach fills and grading for the permanent structures previously described were substantially completed before driving piles, and the piles were driven from the ground surface before excavating for concrete footings. All permanent structures have functioned as planned, with no appreciable settlements, although surrounding ground areas have settled. The top of the bulkhead at the boat basin has shifted 3 or 4 in. toward the water, due to the stress distortion of the sand fill in the cells. The movement occurred before the concrete walks and rails were installed, and no further movement has been noted.

DESIGN OF FOUNDATIONS FOR THE ADMINISTRATION BUILDING

The Administration Building, located at the northerly edge of the "cut area" where an average of over 6 ft of ashes was removed, is of two-story steel-frame construction with stucco exterior walls and, except for these walls, is quite flexible. As it is in a prominent location, it was decided to take no chances on an unsightly exterior. Therefore exterior walls, except court walls, were supported on timber piles, while interior columns were generally supported on spread footings designed for a soil bearing of 1,000 lb per sq ft, load tests on the ash fill having shown that this intensity of loading could be safely used. Settlement of the spread footings was expected, but no forecast of the amount was attempted. Timber piles with 6-in. tips, varying in length from 70 to 90 ft were designed to carry 18 tons under dead, live, and wind loads.

The building was finished and occupied in July 1937, at which time check levels showed about $^1/_8$-in. settlement for exterior, and 1-in. for interior, columns. During the winter of 1938–1939 plaster cracks developed in partitions in the northeast corner of the building, and

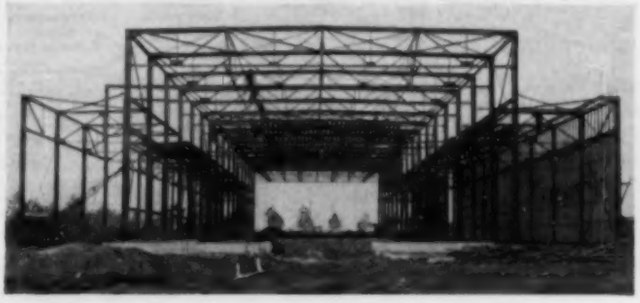

FIG. 5. FRAMING FOR COMMUNICATIONS BUILDING, A TYPICAL EXHIBIT STRUCTURE

check levels run on February 15, 1939, showed that one column in the north wing had settled 5 in., and several others over 4 in., while adjacent exterior columns had settled about $^3/_4$ in. (Fig. 4).

Settlement forecasts then made, on the assumption that in the early stages soil consolidation proceeds proportionately to the square root of the time, indicated an additional inch of settlement by November 1939 and 2 in. by November 1940. While no distress had developed in the superstructure, and the additional settlements would not be injurious, two columns were raised to reduce angular distortion in the affected partitions.

DETAILED STUDY OF EXPOSITION AREA

An extensive soil investigation was made in the exposition area to obtain information for the guidance of the many builders. Load tests on the ash fill, using 5 by 5 and 10 by 10-ft platens of reinforced concrete, showed the yield point of ash fill to vary from 400 to over 2,000 lb per sq ft. Several hundred soil borings

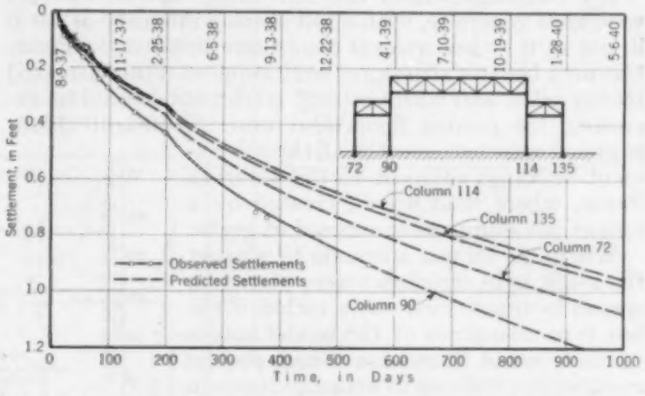

FIG. 6. TIME-SETTLEMENT CURVES FOR COLUMNS IN ONE BENT OF COMMUNICATIONS BUILDING

were made in order to determine more closely the depths of ashes, silt, and sand, and 47 test piles were subjected to load tests. Generally piles loaded to 36 tons for several days showed but slight settlement, which was largely recovered on removal of loads.

Most of the piles tested were driven into the sand under the silt, but several failed to reach the sand, and, although they carried their test loads, they were found to be settling as much as $^1/_4$ in. per month, due to the general settlement of the ground.

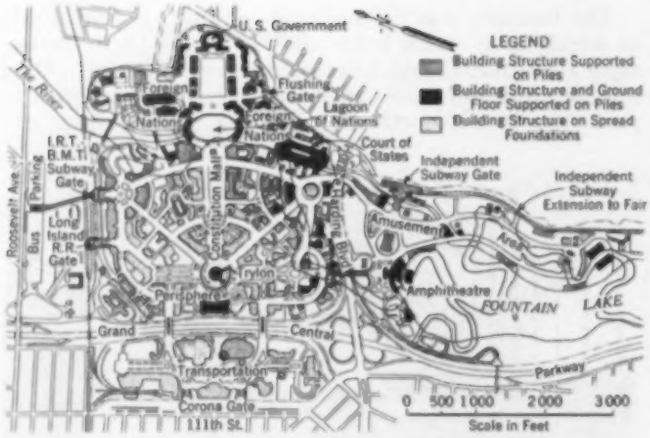

FIG. 7. TYPES OF FOUNDATION FOR PRINCIPAL WORLD'S FAIR BUILDINGS

The Communications Building (Fig. 5) was the first exhibit building to be erected. Its southerly end was on the "cut area," while the northerly end was on ground that had been newly filled to a depth of 6 to 7 ft, the entire area being underlain with ashes to a depth of 24 to 30 ft. The south end footings were designed for a soil bearing of 1,000 lb per sq ft and the north footings for 550 lb per sq ft under exterior, and 700 lb per sq ft under interior columns. No attempt was made at that time to forecast settlement. During a period of five months after construction, observations showed settlements from $1^1/_2$ in. at the southerly to a maximum of $5^3/_4$ in. at the northerly end, and settlement forecasts then made for various bents were plotted (Fig. 6). In two instances injurious differentials were indicated prior to the end of the Fair, and two bents were raised to preclude structural damage due to future settlement. (On March 18, 1940, Column 90 showed a settlement of 1.24 ft, confirming the forecast. See Fig. 6.)

TYPES OF FOUNDATIONS

For buildings within the "cut area," spread footings were used generally, with a soil bearing intensity of 1,000 lb per sq ft or less as local conditions dictated. Outside this area heavier structures were supported on untreated timber piles, and where ground settlements would be excessive, the ground floors also were supported. Floor supports were necessary in all the government buildings adjacent to the Court of Peace, where mud waves, created by a former ash dump, were exposed at grade.

Where the fill was adequate to support the loads, light structures were placed on spread footings; such cases included the box-type structures of the model houses in the Town of Tomorrow, which possess considerable stiffness to withstand uneven reactions. Certain structures were articulated to permit differential settlements without structural injury. Where the cover of ashes was small, all buildings with long-span roofs, two-story occupancy, or heavy construction were supported on piles. Permanent buildings built by the World's Fair Corporation were supported on creosoted timber piles cut off above ground-water level, as were also the heavy Trylon and Perisphere.

Flexible pavement was used for roads throughout the Fair area. In the low areas upward flow of water from the underlying silt and clay made it necessary to provide a subgrade of free draining materials to remove the water as rapidly as possible. Some difficulty with roads resulted from heavy trucking of contractors' equipment and materials; roads that would have carried 10 tons without difficulty were loaded with trucks weighing 25 to 35 tons, and subgrade failures occurred.

Figure 7 shows the Fair as completed in 1939. The principal buildings are shown, with the types of supporting foundations indicated in each case. The large area where the buildings are supported on spread footings coincides generally with the "cut area" where ashes were removed from the old dump. Surrounding this, on the north, east, and south, is a marginal zone where building structures are on piles, but the ground floors are not supported. To the east and south of this marginal area is the low ground where both building structures and ground floors are on piles.

It may be generally stated that where the principles of construction determined by soil mechanics were followed, the results were successful and satisfactory. In the "cut area" small settlements are recorded, while over newly filled areas settlements are greater, as would be expected.

Unfortunately so many factors have intervened that there has been little opportunity to check forecasts against actual performance. Figure 8 is a profile along the Avenue of Pioneers, showing the original grade and observed settlements, the general relation of the settlements to the cut-and-fill zones being evident.

ACKNOWLEDGMENTS

The basic grading and improvement of Flushing Meadow was done by the Department of Parks, City of New York. Madigan-Hyland, consulting engineers for the Department of Parks, developed the grading plans, designed the permanent bridges, and supervised the grading operations. Lazarus White, Walter J. Douglas, Members Am. Soc. C.E., and the firm of Moran, Proctor and Freeman, constituted a "foundation committee" which carried out the detailed foundation studies in the exposition area. Moran, Proctor and Freeman also designed the Boat Basin bulkhead, the dam and tide gate, and foundations for the permanent bridges, and were retained by the Fair as foundation consultants.

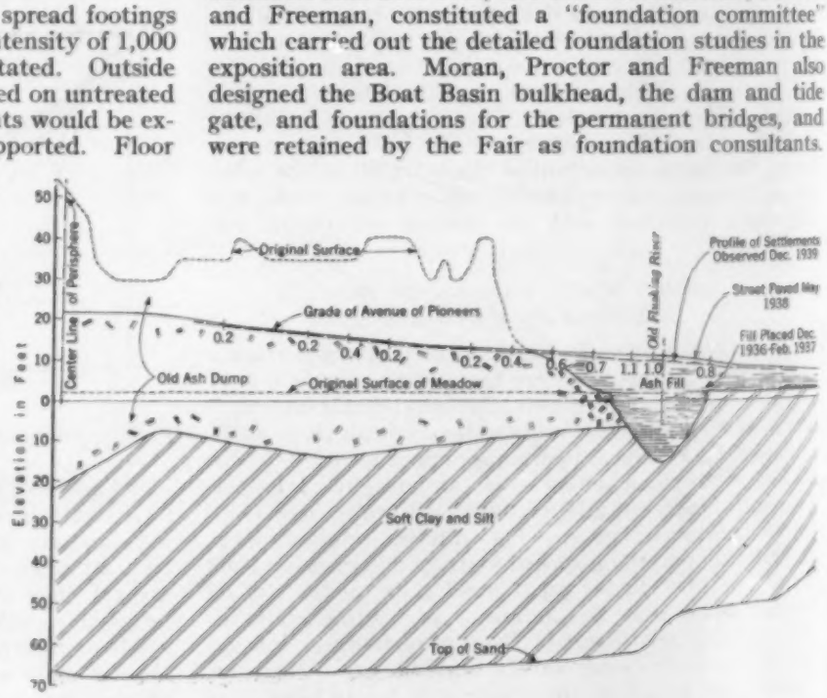

FIG. 8. PROFILE OF AVENUE OF PIONEERS, SHOWING SETTLEMENTS AND SOILS

Water Resources of the Mid-Continent Area

By GEORGE S. KNAPP

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A VARIETY of geographic, climatic, and hydrologic conditions govern the water supply and runoff of the great central part of the United States. Records going back in some instances for over a hundred years are here summarized to indicate that average temperature has been going up appreciably over the past few decades and with it evaporation. These effects, combined with decreasing rainfall, magnify the acute problems of water resources. Mr. Knapp's paper, here abridged, was originally on the program of the Society's Spring Meeting in Kansas City.

THE Mid-Continent area embraces the transition zone between the humid eastern and the arid western parts of the United States. It is a region of great change, from the forest-covered hills along the Mississippi to the vast, smooth, and treeless plains that extend more than two hundred miles eastward from the Rocky Mountains. Lying as it does between the humid and arid zones, the area shows a gradual but definite diminution in annual precipitation from east to west. This is most marked across the southern portion, where in a distance of 600 miles it diminishes from an average of 50 in. per annum in Arkansas to 15 in. at the Texas–New Mexico line. Less abrupt is the change across the northern border, where in nearly twice the distance the rainfall varies from approximately 25 in. in northeastern Minnesota to 15 in. near the mountains in Montana.

From the standpoint of water problems resulting from variations in rainfall, deviations from mean annual amounts are probably of more importance to the engineer than the westward diminution of averages. At Leavenworth, Kans., with 104 years of record, 1836–1939, probably the longest rainfall record in the area, the maximum has been 172% of the mean annual, and the minimum, 42%. Among other long-time Weather Bureau records in the mid-continent area, the maximum appears to be 203% of the average annual at Muscatine, Iowa, and the minimum to be 22%, at Las Animas, Colo.

Humid and arid conditions are in an almost constant process of ebb and flow across the mid-continent area. In periods of abnormal rainfall humid conditions may extend westward almost to the mountains while periods of subnormal rainfall may bring arid conditions into parts of Minnesota, Iowa, and Missouri.

In contrast to many sections of the United States, runoff from most of this area is very small. Only in the southeastern part does a substantial portion of the rainfall appear as runoff. The largest amount, about 15 in., takes place from the more mountainous parts of central Arkansas. Over a vast area comprising the western parts of Kansas, Nebraska, and the Dakotas, and the eastern parts of Colorado, Wyoming, and Montana, the average annual runoff is less than $^1/_2$ in., or below $2^1/_2$% of the rainfall.

A study was recently made of the probable water supply for a proposed irrigation project within this area where the terrain is rolling and some parts of it almost hilly. The conclusion was reached that when regulated by storage the watershed could be expected to yield an average annual supply of 6.7 acre-ft per sq mile. That is equivalent to a runoff of 0.13 in. over the area, or less than 1% of the rainfall. Total runoff, while small, is in general subject to great variation both in annual and seasonal amounts. It is, moreover, influenced in marked degree

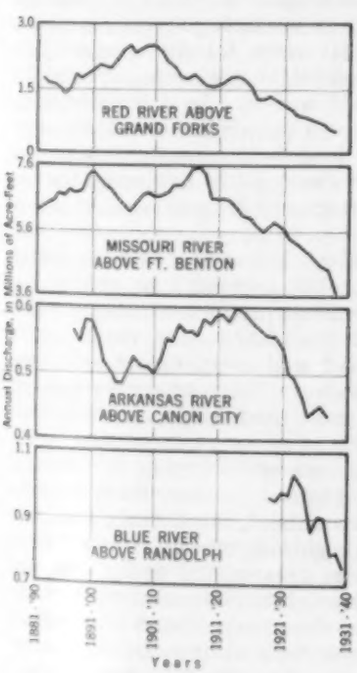
RED RIVER ABOVE GRAND FORKS
MISSOURI RIVER ABOVE FT. BENTON
ARKANSAS RIVER ABOVE CANON CITY
BLUE RIVER ABOVE RANDOLPH
Annual Discharge, in Millions of Acre-Feet
Years

FIG. 1. PROGRESSIVE TEN-YEAR AVERAGE ANNUAL DISCHARGE

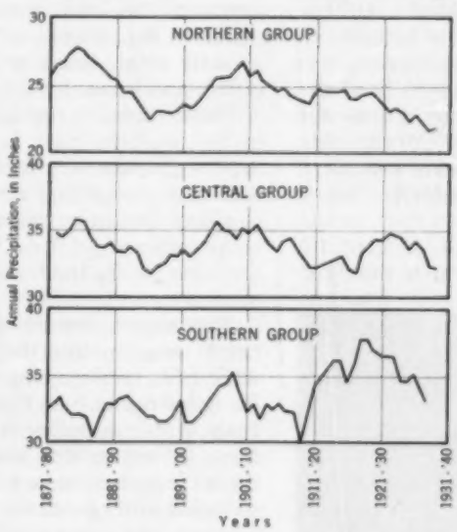

FIG. 2. PROGRESSIVE TEN-YEAR AVERAGE ANNUAL PRECIPITATION

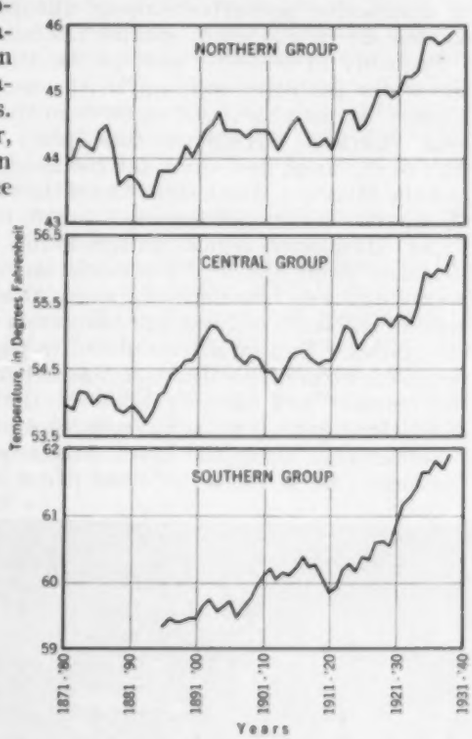

FIG. 3. PROGRESSIVE TEN-YEAR AVERAGE ANNUAL TEMPERATURE

by physical conditions which give streams in certain parts of the area distinct characteristics.

The northeastern part of the area was almost entirely covered during the ice age. Glacial action had a leveling effect, but left the region covered with innumerable pockets and depressions which, having no outlets, became lakes and marshes. There has not been sufficient time since the completion of the work of the ice age for the action of erosion to establish surface drainage over more than a part of the area. Much of the runoff reaches the streams as ground water. In contrast to other parts of the mid-continent area, stream flow is relatively uniform.

Certain streams flowing eastward across the area rise in the high mountains along the continental divide. Among these are the Arkansas, the Platte, and the Missouri with its principal tributary, the Yellowstone. These streams have a distinctive type of seasonal flow known as the June rise, caused by the melting of the accumulated snows coincident with early summer rains. At other seasons of the year stream flow is relatively low. In the foothill reaches, storms of the cloudburst type sometimes cause disastrous floods. Notable among these were the Pueblo flood of 1921 and the more recent ones of Bear Creek and Cherry Creek near Denver.

Over most of the remainder, natural storage, except in the soil, is almost non-existent. Much of the runoff takes place immediately after rains occur. Periods of general rains often produce floods. When rains cease, stream flow declines rapidly. In periods of protracted drought stream flow may cease entirely.

Because of the small average runoff, streams have not carved out channels at all comparable in their relation to the size of the drainage area to those in the more humid sections of the United States. For example, a discharge of 2 cu ft per sec per sq mile will produce flood stages on the Kansas River. That figure is but little more than the average daily discharge of the Tennessee. Thus in a region of limited runoff, floods of destructive proportions occur almost as frequently as they do in regions of greater rainfall.

Probably in no other part of the United States are the water problems incident to the occupation of the country by man as varied as those in the mid-continent area. Earliest settlements took place in the eastern part of the area, first along the banks of the Mississippi and the Missouri, which constituted the principal arteries of travel. Later, settlements spread inland. In the upper Mississippi region settlers found the prairies of southern Minnesota and Iowa rich and productive, but poorly drained. Probably between 20 and 25% of the agricultural lands of Iowa and Minnesota are in drainage enterprises. Still later, stimulated in part by war-time prices for farm crops, drainage was extended to some of the marshes and cut-over lands to the north. Much of this land proved to be unproductive.

Settlements along the lower Mississippi, located for the most part in the broad flood plains which were frequently inundated, faced problems of a different sort; the construction of levees was early a matter of necessity. As protection of one area after another reduced the natural storage in the valley, which had served to reduce crest discharges, higher flood stages resulted. That in turn required the raising of levees. The process of building new levees and the raising of existing ones, until recently, has been an almost continuous one since the beginning of occupation of these river valleys.

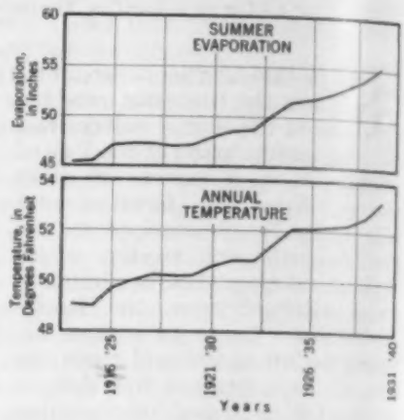

FIG. 4. EVAPORATION AND TEMPERATURE —TEN-YEAR PROGRESSIVE AVERAGES BEGINNING 1914–1923, AT COLBY, HAYS, AND GARDEN CITY, KANS.

Floods on tributary streams have likewise been a continuing problem. Unlike the Mississippi and the Missouri the smaller tributaries have relatively narrow flood plains and are subject to flood peaks of great magnitude but of relatively short duration and small total volume. Past attempts to deal with such floods have usually comprised construction of levees, with some channel straightening. The difficulty of protecting any considerable portion of the flood plain from overflow and at the same time keeping the levees far enough from the channel to provide adequate floodway is readily apparent. Such systems have been expensive for the property owners and only partially successful.

Recent years have seen the establishment of definite levee grades along the Mississippi and the beginning of a program of flood control reservoirs on tributary streams. While the prime purpose of these reservoirs is the control of flood waters, more and more in the mid-continent area they are being built as multiple-purpose reservoirs, combining the storage of water for dry-weather flow regulation and other beneficial uses with capacity for the control of excess flood waters. In doing this there is coming to be recognized a principle which state engineers in the area have long held important, that the water of the area is a resource to be conserved for use as well as at times a destructive agent against which protection is needed.

Those crossing the mid-continent area to make homes in the western part found it necessary to irrigate the deep rich soils to make them productive. On streams like the Arkansas and the Platte, the entire water supplies are now diverted and used, except relatively small amounts of flood waters. Large channel reservoirs are now being built to more completely use such flood waters.

The largest cities in the area are located on the banks of the Mississippi and the Missouri and have water supplies which, while requiring treatment, are entirely adequate for these needs. In the beginning interior cities obtained their water supplies from streams and wells. As they have grown in size and as climatic conditions have reduced supplies, many of them have found it necessary to build storage dams and turn to impounded supplies. Denver, the largest of the interior cities, has obtained its water from the South Platte, but recently found it

MUNICIPAL RESERVOIR FOR HORTON, KANS., EXAMPLE OF NEW TREND IN AUGMENTING REDUCED WATER SUPPLY

necessary to go to the headwaters of the Fraser River on the western slope for an additional supply.

Water power has never assumed a status of major importance in the mid-continent area. Around such natural power sites as St. Anthony Falls at Minneapolis and the Great Falls of the Missouri at Great Falls, Mont., industries of considerable magnitude have grown up to utilize the available water power. In the western part of the area some power is developed as a by-product of the storage of water for irrigation. In the eastern part two notable projects have been built with private capital, the Keokuk plant on the Mississippi, and the Bagnell project on the Osage in central Missouri. Under construction or nearly completed are three water power projects in Nebraska—one on the Loup River and two on the Platte—and one on the Grand River in Oklahoma. All these are financed by PWA grants and loans.

GREAT VARIATION IN RUNOFF ILLUSTRATED BY SOLOMON RIVER AT BELOIT, KANS. Right, in June 1935, Flow 37,800 Cu Ft per Sec; Below, Same Point in January 1935, Flow 3 Cu Ft per Sec

Few long-time records of stream flow are available in the area. Some of the longest are those of the upper Missouri at Ft. Benton, of the Red River of the North at Grand Forks, and of the Arkansas at Canon City; at these points records have been kept continuously since 1881, 1882, 1888, respectively. As shown by ten-year progressive averages in Fig. 1, records at all three stations, while showing upward trends during the early part of the record, have over the past three or four decades developed definite and unmistakable downward trends of far-reaching proportions. On the Missouri River stream flow has declined 49%, while on the Red a decline of more than 80% has taken place. No long-time records are available in the southeastern part of the area. As indicating trend in water supply the record on the Blue at Randolph, Kans. (1919–1939), is also shown.

These declines cannot be accounted for by increased consumptive uses. There is no general use for irrigation on the Red and the Blue. Increased irrigation uses above Ft. Benton can account for not more than 400,000 acre-ft of the 3,800,000-acre-ft decline during this period. There has been but a minor increase above Canon City; that is probably fully offset by water from transcontinental diversions.

Rainfall trends (Fig. 2) do not appear to follow the consistent downward trends of runoff. The "northern group" consists of long-time Weather Bureau stations in Iowa, Nebraska, Minnesota, North and South Dakota; while the "central group" includes records obtained at Leavenworth, Manhattan, and Hays, Kans., and St. Louis, Ore., and Herman, Mo.

In comparison Weather Bureau records at Austin, Tulsa, Lawton, and Oklahoma City, Okla., show that the trend of rainfall in this "southern group" has been generally upward.

Temperatures, even more than runoff or rainfall, show definite and consistent tendencies throughout the entire area. It is noticeable, moreover, that upward trends for the same groups of records began before downward trends in runoff became apparent (Fig. 3).

It is evident that but a small part of the rainfall appears as runoff. Obviously evaporation and transpiration account for the larger part of the rainfall. Information available from a few evaporation pans in the area shows that the evaporation from a water surface for the months April to September, inclusive, amounts to an average of about 35 in. each summer in the northern part and 56 in. in the southern part. This represents the capacity of the atmosphere to absorb water. Actual evaporation is limited to amounts available from rainfall.

Considering trends, it is found that seasonal evaporation has increased in the northern area from an average of 31.38 in. for the ten years 1907–1916, to 38.84 in. for the ten years 1927–1936. In the southern area it has increased from an average of 52.85 in. for the 1908–1917 period to 62.97 in. for the 1930–1939 period. In general (Fig. 4), curves of progressive ten-year averages of evaporation follow closely those for temperatures. If the capacity of the atmosphere to evaporate rainfall has gone up as indicated by these data, then it appears that increasing temperatures have been a material factor in decreasing runoff.

The combined effect of decreasing rainfall and increasing temperature on municipal water supplies is strikingly illustrated by the situation on the Walnut River in Kansas. During the last nine years, rainfall has dropped an average of 2.8 in. from a long-time normal of 31.6 in. Temperatures have gone up 2° from a long-time average of 54.6°. Runoff has been reduced 1.9 in. per year out of a long-time average of 4.6 in. Thus a reduction of 8% in rainfall and an increase of 3.5% in temperatures has effected a 41% reduction in runoff.

Two cities in the Walnut basin, depending on impounded water supplies, use reservoirs constructed more than a decade ago. At the time of their construction these supplies were considered ample for anticipated future needs. The reservoirs are now empty and the cities appear to be faced with the necessity of finding locations for additional storage.

Since temperature trends have been definitely upward for more than 50 years and are still going up at a relatively rapid rate, it appears that we are confronted with no short weather cycle. The effect is likely to continue for many years even if the cycle should soon begin to reverse its trend. Furthermore, it appears that the time has been reached when trends in rainfall and temperatures as well as annual averages of runoff must be taken into consideration in studies of water supplies in the mid-continent area.

Records used in the preparation of graphs in this paper, showing rainfall and temperatures, and showing the runoff of the Red River at Grand Forks up to and including the year 1934, were those used in preparing Geological Survey Water Supply Paper No. 772, "Studies of Relations of Rainfall and Runoff in the United States," by W. G. Hoyt and others, and were made available to the writer by Mr. Hoyt. These data have been brought up to date by M. H. Davison, assistant engineer, Division of Water Resources, Kansas State Board of Agriculture, who also prepared the data on the runoff of the Missouri, Arkansas, and Blue rivers. The evaporation data are from the U.S. Bureau of Plant Industry.

ENGINEERS' NOTEBOOK

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

A Simple Analysis for Eccentrically Loaded Concrete Sections

By L. G. PARKER, ASSOC. M. AM. SOC. C.E., *and* J. J. SCANLON
STRUCTURAL ENGINEERS, WASHINGTON, D.C.

WITH the increasing use of frames in concrete structures, the condition of two-way bending on concrete column sections has become a common but bothersome factor in their design. The authors have applied the solution presented here to a great variety of square, rectangular, and irregular column sections, particularly on projects in seismic areas of the West Coast. Except for the standard assumptions relative to reinforced concrete design, the solution, while neither cumbersome nor deeply involved, is perfectly correct. There is a positive check on each problem.

The use of graphics is too time-consuming and cumbersome for the solution of columns afflicted with high two-way bending moments. Moreover, graphics gives little evidence to the designer as to whether or not he is anywhere near the allowable stress range until he approaches the end of the solution. The solution here offered cuts the designing time to a fraction of that required by graphics and is, in addition, more accurate than any graphical solution.

A NUMERICAL EXAMPLE

Consider the following example. Given the 12 by 12-in. section shown in Fig. 1, reinforced with four 1-in. square bars. Find and check the maximum compressive and tensile stresses on the section.

Composite area = 180 in.^{2}

$$I_{xx} = I_{yy} = 2{,}304 \text{ in.}^4$$

Find stresses at A, B, C, and D.

$$A = \frac{10{,}000}{180} + \frac{31{,}000 \times 6}{2{,}304} + \frac{115{,}900 \times 6}{2{,}304} = +435$$

$$B = \text{do.} + \text{do.} - \text{do.} = -167$$

$$C = \text{do.} - \text{do.} - \text{do.} = -323$$

$$D = \text{do.} - \text{do.} + \text{do.} = +279$$

When the foregoing summations are all found to be positive, the results shown are the correct, final stresses.

If all are not positive, proceed as follows. By proportioning stresses, find points of zero stress along AB and CD; the results are 8.7 and 5.56 (Fig. 2).

First Trial. Determine centers of gravity.

FROM AD		FROM AB	
$12 \times 5.56 (= 66.7 \text{ in.}^2) \times 2.78 \text{ in.}$	$= 185$	$12 \times 5.56 (= 66.7 \text{ in.}^2) \times 6 \text{ in.}$	$= 400$
$12 \times \frac{3.14}{2} (= 18.8 \text{ in.}^2) \times 6.60 \text{ in.}$	$= 124$	$3.14 \times \frac{12}{2} (= 18.8 \text{ in.}^2) \times 4 \text{ in.}$	$= 75$
$9 \times 2 \quad (= 18.0 \text{ in.}^2) \times 2 \text{ in.}$	$= 36$	$19.0 \text{ in.}^2 \times 2 \text{ in.}$	$= 38$
$10 \times 2 \quad (= 20.0 \text{ in.}^2) \times 10 \text{ in.}$	$= 200$		
(123.5 in.^2)	$= 545$	$\frac{19.0 \text{ in.}^2}{123.5 \text{ in.}^2} \times 10 \text{ in.}$	$= \frac{190}{703}$
C.G.: $\frac{545}{123.5} = 4.42$ in.		C.G.: $\frac{703}{123.5} = 5.7$ in.	

MOMENT OF INERTIA

About x-Axis (at C.G.)		About y-Axis (at C.G.)	
$12 \times \frac{(5.56)^3}{12}$	$= 172.0$	$5.56 \times \frac{(12)^3}{12}$	$= 800$
$12 \times 5.56 \times (1.66)^2$	$= 183.0$	$5.56 \times 12 \times (0.3)^2$	$= 6$
$12 \times \frac{(3.14)^3}{36}$	$= 10.0$	$\frac{3.14 \times (12)^3}{36}$	$= 180$
$12 \times \frac{3.14}{2} \times (2.18)^2$	$= 90.0$	$3.14 \times \frac{12}{2} \times (1.7)^2$	$= 55$
$9 \times 2 \times (2.42)^2$	$= 105.0$	$19 \times (3.7)^2$	$= 260$
$10 \times 2 \times (5.58)^2$	$= 622.0$	$19 \times (4.3)^2$	$= 352$
	$1{,}182.0 \text{ in.}^4$		$1{,}623 \text{ in.}^4$

Revised $M_{xx} = 115{,}900 - 10{,}000 \times (6 - 4.42) = 100{,}000$ in.-lb

$$\frac{Mc}{I} = \frac{100{,}100 \times \begin{cases} 4.42 \text{ or} \\ 7.58 \end{cases}}{1{,}182} = \begin{cases} +374 \text{ lb per sq in.} \\ -642 \end{cases}$$

Revised $M_{yy} = 31{,}000 - 10{,}000 \times (6 - 5.7) = 28{,}000$ in.-lb.

$$\frac{Mc}{I} = \frac{28{,}000 \times \begin{cases} 5.7 \text{ or} \\ 6.3 \end{cases}}{1{,}623} = \begin{cases} +98 \text{ lb per sq in.} \\ -109 \end{cases}$$

$$\frac{P}{A} = \frac{10{,}000}{123.5} = +81 \text{ lb per sq in.}$$

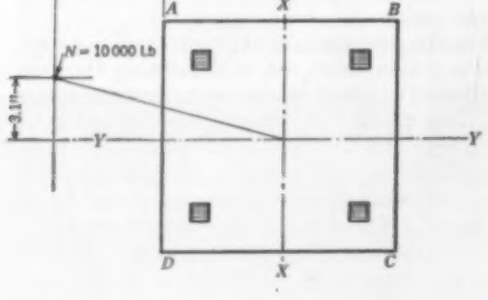

FIG. 1

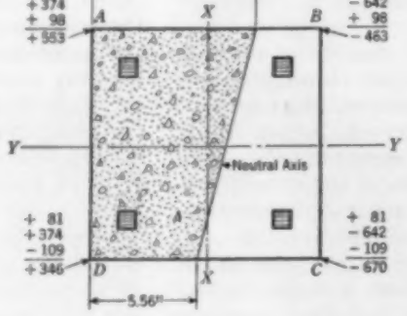

FIG. 2

The preceding stresses have been tabulated on Fig. 2. Position of revised neutral axis:

$$\frac{553 + 463}{12 \text{ in.}} = 84.5$$

$$\frac{553}{84.5} = 6.55 \text{ in.}$$

$$\frac{346}{84.5} = 4.09 \text{ in.}$$

} See Fig. 3

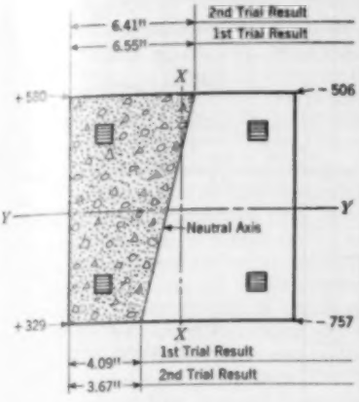

FIG. 3

Second Trial. Next, trial No. 2 was made similarly to trial No. 1, and the results showing the final movement of the neutral axis have been indicated on Fig. 3, together with the final stresses.

Check. The compressive stresses, less the tensile stresses, must be equal to the normal load. Figure 4 shows a stress isometric with the summation of the stresses. This isometric is unnecessary to the correct solution of any problem but is here shown for the sake of clarity.

Volume of compression frustum of stress

$$= 4\,(1{,}858 + 604 + \sqrt{1{,}858 \times 604} \qquad = +14{,}080$$

Compression bar

$$= \left(\frac{10{,}000}{98.5} + \frac{95{,}700 \times 1.98}{1{,}059} + \frac{27{,}600 \times 3.66}{1{,}319}\right) 9 \qquad = +3{,}220$$

Compression bar

$$= \left(\text{do.} + \text{do.} - \frac{27{,}600 \times 4.34}{1{,}319}\right) 9 \qquad = +1{,}715$$

Total compression $+19{,}015$

Tension bar

$$= \left(\text{do.} - \frac{95{,}700 \times 6.02}{1{,}059} + \frac{27{,}600 \times 3.66}{1{,}319}\right) 10 = -3{,}665$$

Tension bar

$$= \left(\text{do.} - \text{do.} - \frac{27{,}600 \times 4.34}{1{,}319}\right) 10 = -5{,}340$$

Total tension $-9{,}005$ $-9{,}005$

Total compression $+19{,}015$

Checks normal load $+10{,}010$

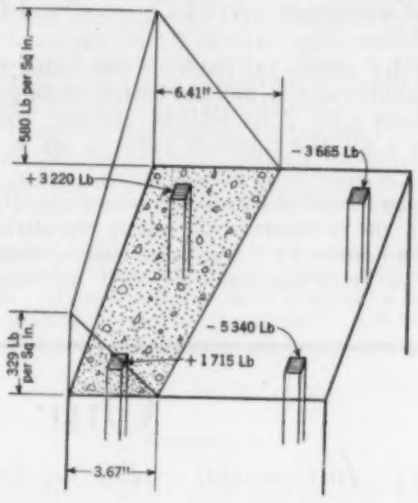

FIG. 4

Parameter of Catenary Curve for Any Given Span and Dip

By DONALD BREGMAN
CIVIL ENGINEER, LOS ANGELES, CALIF.

THE unknown parameter of a catenary curve (Fig. 1) for a given span and dip (of chain, round-bottom bin, etc.) may be readily obtained from either Table I or Fig. 2 of this article. These have been prepared by the writer with the aid of the well-known equation, $y = \frac{a}{2}\left(e^{\frac{x}{a}} + e^{-\frac{x}{a}}\right)$, and were arrived at in the following manner:

Using the notation of Fig. 1, for the end point of the curve to the right of axis Y-Y, we have the coordinates $x = b$ and $y = D + a$. Substituting these in the catenary equation, designating b/a by k, and transposing D, we have the equation:

$$a = \frac{2D}{e^k + e^{-k} - 2} \qquad \ldots\ldots\ldots\ldots (1)$$

For $D = 1$, Eq. 1 further reduces to:

$$a_1 = \frac{2}{e^k + e^{-k} - 2} \qquad \ldots\ldots\ldots\ldots (2)$$

Hence, for any value assigned to k, we have the corresponding value of a_1, and the desired parameter a is of course expressed by

$$a = D \times a_1 \qquad \ldots\ldots\ldots\ldots (3)$$

Also, from the foregoing relations (by substituting b/k for a in Eq. 3), we have the further relation

$$b/D = a_1 k \qquad \ldots\ldots\ldots\ldots (4)$$

In Table I the values of a_1 were first computed and recorded in Col. 2, for different values of k in Eq. 2 (the Napierian base e having been taken as 2.7182818 and its common logarithm as 0.4342945). The values of

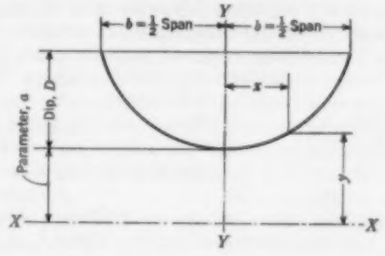

FIG. 1. NOMENCLATURE

$a_1 k = b/D$ were then computed for Col. 3. For any given span and dip, therefore, b and D being known, their

TABLE I. CATENARY PARAMETERS

(1) k	(2) a_1	(3) $a_1k = b/D$	(1) k	(2) a_1	(3) $a_1k = b/D$
0.1	220.330	22.033	0.8	2.964	2.371
0.15	88.990	13.350	0.9	2.309	2.078
0.2	49.835	9.967	1.0	1.846	1.846
0.25	31.852	7.963	1.5	0.739	1.119
0.3	22.050	6.615	2.0	0.368	0.737
0.35	16.152	5.653	2.5	0.196	0.490
0.4	12.337	4.935	3.0	0.110	0.330
0.45	9.713	4.371	3.5	0.064	0.224
0.5	7.837	3.919	4.0	0.038	0.152
0.6	5.392	3.235	4.5	0.023	0.102
0.7	3.919	2.743	5.0	0.014	0.070

ratio $b/D = a_1k$ may be found in Col. 3 and the corresponding value of a_1 read from Col. 2. The parameter a sought is then $D \times a_1$.

To aid in determining intermediate values, the data in the table were plotted in Fig. 2. For convenience, two curves are presented—curve A for the larger values of a_1 and a_1k (covering the data for the first ten values of k); and curve B for the remaining data in the table.

As an illustration, let it be required to find the parameter of a catenary curve for $b = 267$ and $D = 20$, or $b/D = 13.35$.

Solving by means of Table I, the value of $b/D = 13.35$ is found in Col. 3, and the corresponding value of a_1 is read from Col. 2 as 88.990. Hence, the required parameter a for the catenary curve is $20 \times 88.990 = 177.98$.

Solving by means of Fig. 2, the values of $b/D = 13.35$ is located on the ordinate scale (using the divisions from zero to 30 for curve A). The point corresponding thereto on curve A gives the value of 89.0, sufficiently close, on the abscissa scale (using the divisions from zero to 400).

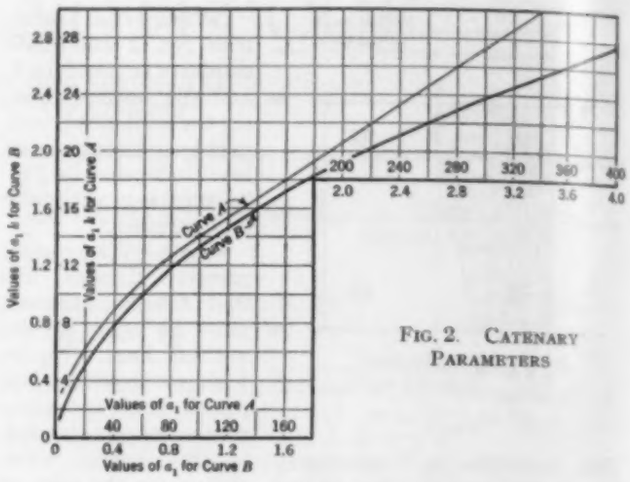

FIG. 2. CATENARY PARAMETERS

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

History of Golden Gate Bridge Permit

TO THE EDITOR: In the June issue Admiral Whitman touched briefly on War Department action in connection with the permit for the Golden Gate Bridge. As later discussion in your columns indicates that several points in that action are not thoroughly understood, it seems desirable to review the whole case in some detail.

The proposition to build the Golden Gate Bridge was brought before Secretary of War Weeks in 1924. The Secretary wrote a letter to the proponents stating in effect that he viewed the proposition favorably, but that before a permit could be given the War Department must have plans of the proposed bridge. The proponents evidently regarded this letter as of the force of a permit, and went ahead to prepare complete plans when practically all that the War Department required was the exact location of the bridge and its horizontal and vertical clearances. The War Department is concerned only with the effect of the structure on navigation unless the bridge is an interstate affair. The proponents of the bridge took a large risk when they went to the expense of detailed plans before they got their permit, which Secretary Weeks' letter did not constitute at all.

A permit requires the joint approval of the Chief of Engineers of the Army and the Secretary of War. Whoever drafted Secretary Weeks' letter appears to me to have been exceedingly careless in giving or allowing the impression that complete plans were necessary, and the ignorance—if ignorance it was—on the part of the bridge proponents as to what was required seems to be inexcusable.

About 1927 the Chief of Engineers of the Army refused to approve the permit. This refusal was based on an understanding between the War and Navy departments that the Chief of Engineers would approve of no bridge across the entrance of what might be called "a strategic harbor" of the United States. In general, that agreement was based on sound reason.

Sometime about 1930 or 1931 the proponents of the bridge appeared before Mr. Davidson, acting Secretary of War, and presented the letter of Secretary Weeks and said that they now came to get their "formal permit," considering the Secretary's letter as an informal permit. Mr. Davidson summoned the Chief of Engineers to the meeting. The former chief had denied the permit; this one had taken no action, but he informed the meeting that Secretary Weeks' letter was no permit and that before one could be issued there must be a public hearing in San Francisco and the entire proposition must be examined critically. To this the proponents in Mr. Davidson's office objected strongly, saying that a public hearing would give the impression that the project was questionable and the vote on the bond issue due a few months in the future might be adversely affected. The Chief of Engineers informed them that if they were accused of choking off a public hearing the adverse effect on the vote would certainly be magnified, and that a public hearing, as customary and proper, in so important a matter to the community and to the country as a whole would be held.

The public hearing was held, and all interests were consulted, including the Navy Department. The policy of not building a bridge over the entrance to a "strategic" harbor was thought to be generally sound, but the great depth of water in the Golden Gate made an exception to the general policy permissible.

This is probably the only harbor in the United States where an exception to the general policy as aforestated is acceptable.

It seems appropriate at this particular time to recall this case and the inadvisability of doing anything that might make possible the blocking of the entrance to any one of our great harbors.

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Major-General, U.S. Army

Franklin, Tenn.

Use of Modern Surveying Instruments Vital

TO THE EDITOR: While the note by R. A. MacGregor on the use of an antique surveying instrument, which appeared in the "Our Readers Say" department of the July issue, is interesting, I wonder what Mr. MacGregor had in mind. I am sure he would not urge engineers to use instruments that should be in the museums or on the scrap pile.

Perhaps the laying out of lots in a boom town might be done with an old-fashioned instrument or even without any instrument at all. But no one would think today of using an obsolete instrument in making boundary surveys of property that had any material value.

I remember seeing, when I was a youngster back in the nineties, the grading of a new railway carried on with wheelbarrows and

dump carts pulled by two mules. The work was done in a wonderfully efficient manner for the time, no doubt as efficiently as was the surveying of which Mr. MacGregor spoke. But who would do the grading of a railway or highway today with horses and mules and wheelbarrows? We use the steam shovel and the 5- and 10-ton truck and get the job done at the minimum unit cost and in the minimum time.

It is a sad commentary on the engineering profession that in most of the teaching of surveying in our educational institutions the student must use equipment that cannot inspire him. He must look upon surveying as a very crude branch of engineering. Students of surveying or any other subject should be taught with the very best equipment. I recall having seen a few years ago a statement to the effect that in the Ford plant there is a room set aside for the teaching and training of young men in the use of tools and machines. This room, it was stated, was fitted with the most modern equipment. With such fine tools and implements the young man would be inspired to do his best, whereas if he were being trained with obsolete equipment he undoubtedly would not be so keen to learn, nor could he feel that becoming an automobile mechanic would be a very high calling.

Good surveying instruments are now on the market and can be purchased for a moderate sum. It is true that a good instrument costs more than a poor one, just as a good suit of clothes costs more than one that is made of shoddy material.

Some years ago a professor of civil engineering in one of the leading technical schools wrote me a letter in which he asked whether he could borrow or purchase an obsolete direction theodolite from the organization which which I was connected. He informed me that he wished to teach his students the use of this type of instrument and he had none in his stock. I replied that I was thoroughly disgusted with the idea that he should want to teach his students with junk and expressed the view that students should have the best rather than the poorest type of instrument. I also informed him that I would not recommend that an instrument be sent to him, if we had one. A few days after sending the letter I received a very appreciative reply to the effect that the professor had showed my letter to his purchasing agent and asked him what to do. The latter said, "Go and get your theodolite." It seemed that the professor had for several years tried to purchase a modern theodolite, but the purchasing agent had turned his request down because he said the instrument was not needed.

We must honor the memory of those manufacturers of surveying instruments back in the last century, who did the best they could. In fact, their efforts were the basis for the development of the modern surveying instruments. Let us be rational and exercise the same judgment in the purchase and use of surveying instruments that we do in the purchase and use of equipment in other branches of engineering.

WILLIAM BOWIE, M. Am. Soc. C.E.
Hydrographic and Geodetic Engineer (Retired), U.S. Coast and Geodetic Survey
Washington, D.C.

Surveying and Mapping in the Early Days

TO THE EDITOR: The interesting article by Edward Dyer Kingman in the August issue, "Roger Sherman, Colonial Surveyor," does not state that Sherman was United States Senator from Connecticut. However, I am chiefly interested in discussing the statement that, "In 1622 appeared the first map of any part of the English Colonies situated in the New World, a map that in 1627 was incorporated in Capt. John Smith's *History of Virginia*."

On March 22, 1916, the writer received the following from the Chief of Division of Maps and Charts, Library of Congress, Washington, "Regarding information concerning John Smith's map and relation of Virginia, the book was first published in 1608 under the title, 'a true relation of such occurrences and accidents of note as hath happened in Virginia since the first planting of that Colony which is now resident in the South part thereof till the last return from thence. London 1608.' We find no information regarding map and infer that it was made after the sailing of Nelson in June 1608, during Smith's three months' exploration of the Chesapeake Bay."

Captain John Smith's adventure with Powhatan's Indians is given in an account published in London in 1613, as follows: "Captain John Smith hath acquainted me with that whereof himselfe with great peril and paine, had been the discouverer, being in his discouveries taken prisoner and escaping their furie, yea receiving much honor and admiration among them, by reason of his discourses to them of the motion of the Sunne, of the parts of the World, of the Sea, etc., which was occasioned by a Dyall (Compass) then found about him."

In 1916 the writer saw on display at the Headquarters of the American Society of Civil Engineers a map of Virginia, dated 1606, made in London from notes of Capt. John Smith. This map shows the Chesapeake Bay for its entire length, the Susquehanna River, the Potomac and James rivers, a sketch of the giant Susquehanna Indian, and a sketch showing the interior of Powhatan's house with this legend: "Powhatan held this state and fashion when Capt. Smith was delivered to him prisoner, 1607." There are also shown the seal of England, points of the compass, scale of leagues and half leagues, the location of very high trees, the location of the "kings' [Indian chiefs'] houses," and names of Indian tribes. The map was presented to the Society by the late L. W. Page, M. Am. Soc. C.E., who said "It is my recollection that Capt. John Smith made the surveys for this map with only a pocket compass, and that he took such data as he collected to England and had the map drafted by an expert draftsman." The writer photographed the map and had it enlarged and framed, and it now hangs in his home.

HANSON Z. WILSON, Assoc. M. Am. Soc. C.E.
Brooklyn, N.Y.

The Engineer Should Explain Himself to the Public

TO THE EDITOR: On page 453 of the July number of CIVIL ENGINEERING there appears a letter by William Bowie, M. Am. Soc. C.E., deploring the notorious "ineptness of engineers in presenting an attractive picture of their profession to the public."

The subject is worthy of attention beyond the ranks of the engineers themselves. Major Bowie recounts the difficulties of the publicity manager at one of the Society's quarterly meetings. The public is definitely interested in the reasons back of our solutions to certain problems. For instance, an entire region is interested in great projects, such as Boulder Dam or the Golden Gate Bridge, and probably hundreds of engineers having no connection with those projects will be questioned about various features of the work that the layman has seen in newsreels or newspapers. The public is equally interested in the smaller projects that abound, and anyone having the remotest connection with such a project is asked numberless questions as to the reasons for cost, location, the peration of the completed structure, and so on.

The writer is of the opinion that this public interest should be cultivated, as public support for timely projects may be gained in this way, or public disapproval for worthless projects furthered by a more intimate understanding on the part of the public of the merits of individual cases.

While it is not necessary for an engineer to be inarticulate before the layman, it is not unnatural that he should be. The engineer views his project as only an engineer can; if he is asked what "tough engineering problems had to be handled," it is but natural that he should say, "there were none." However, the engineer remains a human being, who is proud of his work and will recount the problems he must certainly have encountered, if asked about them in his own terms. A lay interviewer is perhaps at a disadvantage in attempting to "cover" an engineer because he is unprepared to pose questions that will elicit a substantial reply. More unfortunately, the interviewer may not sufficiently understand a substantial reply, if he succeeds in obtaining it, to pursue it with further pertinent questions, or to report it intelligently to the public.

One means the writer suggests as a correction to the difficulty would place men with engineering education and a few years' engineering experience in journalistic positions. Some engineers have sufficient command of the language, sufficient writing ability, and sufficient skill with a camera, to perform such a function creditably; whether men trained as journalists could gain conversance with engineering subjects without a prolonged, wasteful process of study is questionable. At present, it appears to the writer that

reporters visit engineering projects only in the company of high-titled dignitaries or on the occasions of accidents. For ordinary periodic reports on construction progress or the technical features that interest the public, reporters rarely appear to know the proper channels through which to obtain information.

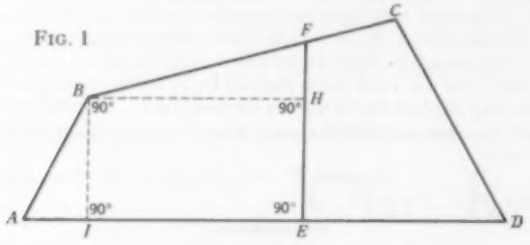
The writer believes his suggested solution would afford a valuable means of instructing the public through periodical literature. It might also be enlightening to engineering students, who certainly read the newspapers and magazines, and discuss them in the fraternity house and on the steps of the library building.

South Pasadena, Calif. JACK SYLVESTER, Jun. Am. Soc. C.E.

Solving Land Subdivision Problems

TO THE EDITOR: In connection with Mr. Kinslow's article, in the August issue, on the use of the graphical method in the solution of land subdivision problems, the writer submits a method

FIG. 1



he has used, which is absolutely accurate and involves no drawing of trial lines or any trial and error.

After solving triangle ABJ (Fig. 1) and deducting its area from the required area, the location of the line FE is found as follows:

$$\frac{(2BJ + JE \tan FBH)JE}{2} = \text{Area } BFEJ$$

$$JE = \frac{JB}{\tan FBH} \pm \sqrt{\frac{2 \text{ Area } BFEJ}{\tan FBH} + \frac{\overline{JB}^2}{\tan^2 FBH}}$$

W. G. FROST, M. Am. Soc. C.E.
Redwood City, Calif. *Civil Engineer*

Trends in the Profession

TO THE EDITOR: If the facts and trends indicated by the article in the July issue, entitled "Engineering Trends in California," by Robert O. Thomas, are representative of nation-wide conditions in the structure of the civil engineering profession, this article furnishes much food for thought, not alone by the Society officials and members, but also by younger men considering civil engineering as their life work.

The facts presented by this article definitely establish two trends: (1) That the private practitioner in civil engineering is fast disappearing, and (2) that future employment in civil engineering will be predominantly in the field of public service. They also appear to indicate that publicly employed civil engineering organizations are supplanting private practitioners. The following tabulation brings this fact out, and also indicates that the above trends were definitely under way prior to the advent of the current depression. While no one expects these trends to continue at the

PERCENTAGE OF TOTAL MEMBERSHIP IN CALIFORNIA

YEAR	Public Service	Professional Practice	Total
1924	20.4	29.8	50.2
1929	29.1	25.1	54.2
1934	32.4	15.4	47.8
1939	44.9	14.5	59.4

above rate, it is interesting to note that, if they did so, shortly after 1950 the percentage of those engaged in private practice would become zero, and by about 1975 all members of the Society in California would be employed in public service.

Another significant fact brought out by the article is the great increase in employment of younger engineers, as represented by Juniors, in the field of public service, and the decrease in the relative number employed by private practitioners. This last is probably due not alone to the decreasing proportion of members engaged in private practice, but also to the decrease in the volume of work handled by each of them, which prevents them from employing younger men as assistants in their offices.

Mr. Thomas' comment upon the probable lack of opportunity for advancement encountered by Juniors employed in public service is borne out by the writer's experience during the past three years in serving on the Local Membership Committee of the Society. Juniors employed in public service and appearing before this Committee as applicants for transfer to the grade of Associate Member almost invariably have had less experience in responsible charge of engineering work, or have greater difficulty in convincing the Committee that they have had the requisite one year of responsible charge, than those employed in other fields.

If the conditions and trends referred to in the article are representative of those existing nationally, the article would seem to pose the following questions as food for thought and action:

1. Does the private practitioner in civil engineering serve a useful purpose in the present-day economic and social structure, and if so, should not efforts be made, not alone by the Society and the profession but by society as a whole, to perpetuate his existence?
2. Are opportunities for professional advancement for civil engineers employed in public service more limited than in other fields of employment, because of the greater amount or proportion of routine work performed, the greater proportion of subordinates employed in public service organizations, or for some other reason?
3. If the second question is correct, should not engineering educators take cognizance of this situation and modify the length and content of courses offered in civil engineering? Obviously if there are only a small proportion of civil engineering positions in the upper brackets and the large proportion of positions are in the lower brackets and of a more or less routine nature, it would appear inadvisable to train large numbers of men for holding positions that will probably never exist.

DONALD M. BAKER, M. Am. Soc. C.E.
Los Angeles, Calif. *Consulting Engineer*

Comments on Model Studies of Overflow Spillway Section

DEAR SIR: The experimental data presented in the article on "Model Studies of Overflow Spillway Section" by A. S. Offitzeroff, in the August issue, would indicate that an overflow dam with a 45-deg downstream face, a vertical upstream face, and crest shaped to the coordinates indicated might function with a discharge coefficient C in the well-known formula, $A = CbH^{3/2}$ of 4.3 for a head 2.5 times the design head.

Such values can be obtained only by adding some portion of the atmospheric head to the water head by the creation of a sub-atmospheric pressure underneath the overflowing sheet. It is very doubtful if transference of the model results to such a prototype is valid. In order to secure similitude in such cases the experiments should have been conducted in an air-tight enclosure in which the atmospheric pressure was reduced to conform to the model scale.

Portland, Ore. J. C. STEVENS, M. Am. Soc. C.E.

Extraction of Square Root Simplified

DEAR SIR: In reference to Mr. Di Lorenzo's article, "Simplified Extraction of the Square Root," in the May issue, another proof or method can be obtained by using the calculus. Setting $y = x$, and taking the differential, we have $dy = \frac{dx}{2\sqrt{x}}$. Thus any remainder from a perfect square can be considered to be dx, and by dividing by twice the square root we obtain dy.

In using the present-day calculating machine this method comes in very handy. It is necessary only to determine enough of the answer to make dx fairly small and then complete the answer by straight division. The normal expectancy by this method is that the next three places after straight division is employed will be correct.

Phoenix, Ariz. JULIAN W. POWERS, Assoc. M. Am. Soc. C.E.

Fall Meeting in Cincinnati, Ohio

Hotel Netherland Plaza to Be Headquarters, October 16–18, 1940

Program of Meetings, Entertainment, and Trips

Opening Session and General Meeting

WEDNESDAY—October 16, 1940—Morning

9:00 **Registration**

General Meeting

Morning and Afternoon

10:00 **Fall Meeting called to order by**

RUPERT A. ANDEREGG, *President, Cincinnati Section, Am. Soc. C.E.; Associate Professor, Civil Engineering, University of Cincinnati,* Cincinnati, Ohio.

10:05 **Address of Welcome**

HIS HONOR JAMES GARFIELD STEWART, *Mayor of the City of Cincinnati,* Ohio.

10:30 **Response**

JOHN P. HOGAN, *President, American Society of Civil Engineers,* New York, N.Y.

10:40 **The Progress of City Planning**

ALFRED BETTMAN, *Attorney-at-Law; Chairman, City Planning Commission,* Cincinnati, Ohio.

11:30 **Discussion of City Planning**

12:00 **Luncheon recess**

WEDNESDAY—October 16, 1940—Afternoon

2:00 **The Civic Responsibilities of the Engineering Profession**

E. B. BLACK, *M. Am. Soc. C.E., Consulting Engineer* Kansas City, Mo.

2:30 **Discussion opened by**

IVAN C. CRAWFORD, *M. Am. Soc. C.E., Dean, College of Engineering, University of Michigan,* Ann Arbor, Mich.

ARTHUR C. EVERHAM, *M. Am. Soc. C.E., Director of Public Works,* Kansas City, Mo.

W. W. HORNER, *M. Am. Soc. C.E., Consulting Engineer; Professor, Municipal and Sanitary Engineering, Department of Civil Engineering, Washington University,* St. Louis, Mo.

3:00 **Municipal Sanitation**

FRANK C. TOLLES, *M. Am. Soc. C.E., Consulting Engineer, Gascoigne and Associates,* Cleveland, Ohio.

3:30 **Discussion opened by**

F. H. WARING, *M. Am. Soc. C.E., Chief Engineer, Division of Sanitary Engineering, State Department of Health,* Columbus, Ohio.

3:45 **Municipal Transportation**

ERNEST P. GOODRICH, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

4:15 **General discussion**

VIEW OF CENTRAL PARKWAY, CINCINNATI, OHIO

GLARELESS LIGHTING, COLUMBIA AVENUE VIADUCT

Dinner and Entertainment

WEDNESDAY—October 16, 1940—Evening

7:15 **Dinner and Entertainment**

Address, "The Function of the City," by COL. WILLARD T. CHEVALIER.

Social Hour

Dancing, Continentale Room

Tickets for the dinner and evening's entertainment are $2.50 each.

Student tickets, $2.00 each

Sessions of Technical Divisions Occupy Ent

POWER DIVISION

Morning and Afternoon

Power Division Program

prepared by

Committee on Progress in Power Plant Design

WILLIAM P. CREAGER, *Chairman, Executive Committee, Presiding*

9:00 Trend in Hydraulic Turbine Practice (a closure of the discussion of the topic presented at the October 1938 meeting)

I. A. WINTER, *Assoc. M. Am. Soc. C.E., Senior Engineer, U.S. Bureau of Reclamation,* Denver, Colo.; *Chairman, Power Division Subcommittee on Progress in Prime-Mover, Design and Efficiency.*

9:30 European and American Cavitation Laboratory Practice

L. M. DAVIS, *Assoc. M. Am. Soc. C.E., Hydraulic Test Engineer, Pennsylvania Water and Power Company,* Holtwood, Pa.

10:00 Ventilation of Hydroelectric Generating Stations and Generator Cooling

E. H. BANCKER, *Central Station Engineering Department, General Electric Company,* Schenectady, N.Y.

10:30 General discussion

12:00 Luncheon recess

2:00 The Long-Range Trend in Power House Space Limits

H. G. GERDES, *M. Am. Soc. C.E., Consulting Hydroelectric Engineer, Harza Engineering Company,* Charleston, S.C.

2:30 Economic Design of Waterways and Gates for Hydroelectric Developments

G. R. RICH, *M. Am. Soc. C.E., Head Mechanical Engineer, TVA,* and R. M. RIEGEL, *M. Am. Soc. C.E., Head Civil Engineer, Design Department, TVA,* Knoxville, Tenn.

3:00 General discussion

CITY PLANNING AND SURVEYING AND MAPPING DIVISION

Morning

HARLAND BARTHOLOMEW, *Chairman, Executive Committee, City Planning Division, Presiding*

9:30 Specific Examples of Municipal Financial Savings in Cincinnati, as a Result of the Master City Plan

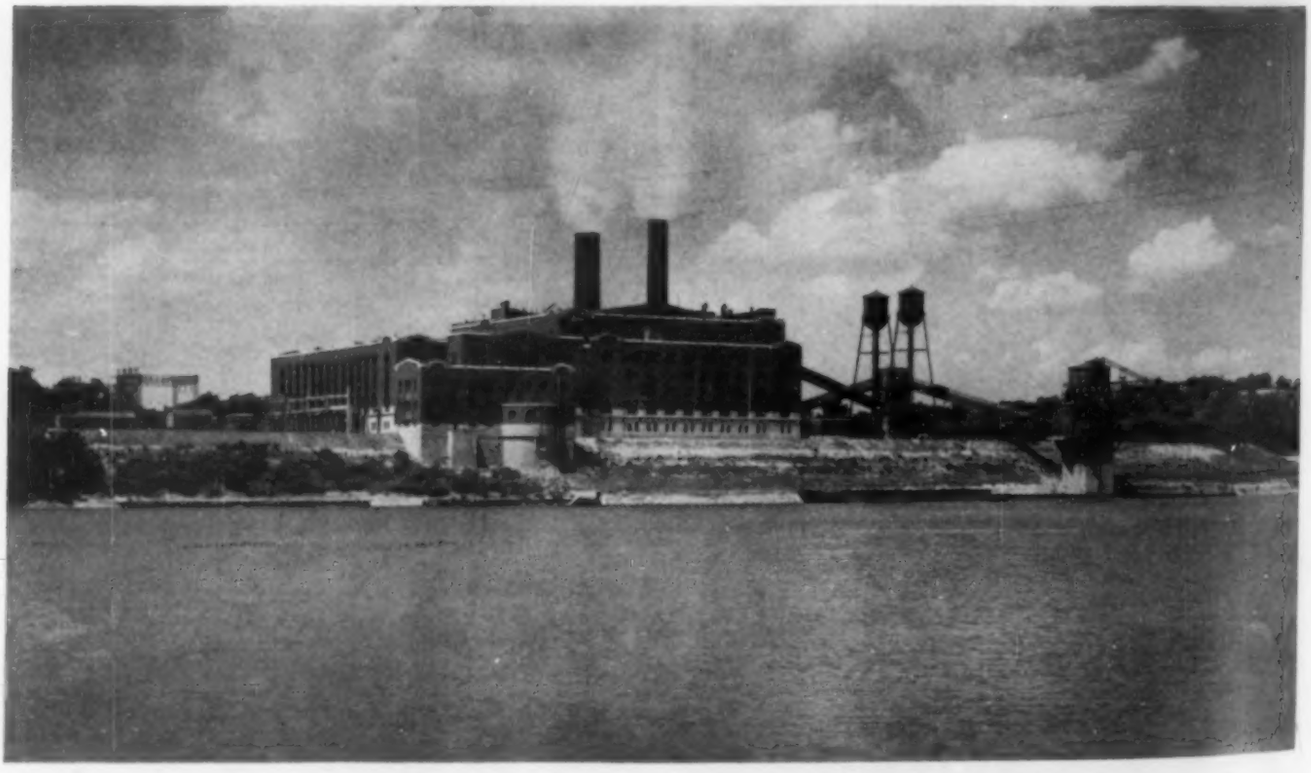
ALFRED BETTMAN, *Attorney-at-Law; Chairman, City Planning Commission,* Cincinnati, Ohio.

10:00 The Topographic Map and City Planning

HUGH C. MITCHELL, *Senior Mathematician, Division of Geodesy, U.S. Coast and Geodetic Survey,* Washington, D.C.

10:30 Discussion opened by

W. N. BROWN, *M. Am. Soc. C.E., President, W. N. Brown, Inc.,* Washington, D.C.



COLUMBIA ELECTRIC GENERATING STATION OF THE CINCINNATI GAS AND ELECTRIC COMPANY

Entire Day Thursday, October 17, 1940

SANITARY ENGINEERING DIVISION

Afternoon

EARLE L. WATERMAN, *Chairman, Executive Committee, Presiding*

2:00 **Toledo's Lake Erie Water Project**

GEORGE N. SCHOONMAKER, *M. Am. Soc. C.E., City Manager,* Toledo, Ohio.

Discussion opened by

PAUL HANSEN, *M. Am. Soc. C.E., Consulting Engineer,* Chicago, Ill.

3:00 **Development of Municipal Water Supply, Water Purification, Sewage Treatment, and Stream Pollution Control in Ohio**

F. H. WARING, *M. Am. Soc. C.E., Chief Engineer, Division of Sanitary Engineering, State Department of Health,* Columbus, Ohio.

Discussion opened by

F. C. DUGAN, *M. Am. Soc. C.E., Chief Engineer, State Board of Health,* Louisville, Ky.

B. A. POOLE, *Assoc. M. Am. Soc. C.E., Chief Engineer, Bureau of Sanitary Engineering, State Board of Health,* Indianapolis, Ind.

3:50 **The New Bio-Chemical Sewage Treatment Plant at Anderson, Ind.**

B. A. POOLE, *Assoc. M. Am. Soc. C.E., Chief Engineer, Bureau of Sanitary Engineering, State Board of Health,* Indianapolis, Ind.

4:20 **General discussion**

HIGHWAY DIVISION

Afternoon

WILLIAM NELSON CAREY, *Chairman, Executive Committee, Presiding*

2:00 **State and Federal Routes Through Municipalities**

H. G. SOURS, *Assoc. M. Am. Soc. C.E., Assistant Director and Chief Engineer, State Highway Department,* Columbus, Ohio.

2:30 **State Highway Planning Survey**

T. H. CUTLER, *M. Am. Soc. C.E., State Highway Engineer, State Department of Highways,* Frankfort, Ky.

3:00 **Highway Research in Indiana**

K. B. WOODS, *Assoc. M. Am. Soc. C.E., Assistant Professor, Highway Research, Department of Civil Engineering, Purdue University; Assistant Director, Joint Highway Research Project, State Highway Commission,* Lafayette, Ind.

3:30 **General discussion**

©*Fairchild Aerial Surveys, Inc.*

LUNKEN AIRPORT, CINCINNATI, OHIO

©*Bowman Park Aero Co.*

CINCINNATI UNION TERMINAL AND FACILITIES

THURSDAY—October 17, 1940

Afternoon

4:00 **SPECIAL TOUR OF CINCINNATI**

Starting from the hotel at 4:00 p.m., members, ladies and guests will be taken by bus on a specially arranged tour of Cincinnati.

The tour will give in comprehensive scope an opportunity to see the scenic, civic, and industrial city. It has been designed to be an enjoyable, profitable, and interesting part of the meeting.

The party will be returned to the hotel about 6:00 p.m.

Tickets for the tour are $1.50 each.

Evening

7:15 **DINNER AND ENTERTAINMENT, The Pavillon Caprice**

Address, "Glaciers Over Cincinnati," by DR. NEVIN M. FENNEMAN, *Professor of Geology, University of Cincinnati.*

Dancing, Continentale Room

Tickets for the dinner and evening's entertainment are $2.50 each. Student tickets, $2.00 each.

The story of the sculpturing of the splendor of Cincinnati's scenery, which has inspired the title, "Queen City of the West," is fascinating. The tale of the laying down of the old Cincinnatian sea-bottom rock layers and their subsequent dramatic fate at the southern edge of four glacial movements is as absorbing as fiction.

General Meeting

Friday—October 18, 1940—Morning

R. P. DAVIS, *Vice-President, Am. Soc. C.E., Presiding*

10:00 Esthetic Responsibilities of the Engineering Profession

HAROLD M. LEWIS, *M. Am. Soc. C.E., Consulting Engineer; Chief Engineer and Secretary, Regional Plan Association, Inc.*, New York, N.Y.

10:30 Discussion opened by

L. V. SHERIDAN, *M. Am. Soc. C.E., Counselor, Region 4, National Resources Planning Board*, Indianapolis, Ind.

HARRY B. TOUR, *Assoc. M. Am. Soc. C.E., Senior Architect, TVA*, Knoxville, Tenn.

11:00 Municipal Organization from the Engineering Viewpoint

C. O. SHERRILL, *M. Am. Soc. C.E., City Manager*, Cincinnati, Ohio.

11:30 General discussion

Inspection Trip to the American Rolling Mills Company at Middletown, Ohio

FRIDAY—October 18, 1940

Afternoon and Evening

1:00 Inspection Trip to the American Rolling Mills Company at Middletown, Ohio

Following luncheon, members, ladies, and guests will assemble in the hotel lobby for departure at 1:00 p.m. sharp. The trip will be an hour's bus ride through rolling Ohio countryside to one of the country's major steel producing plants, the home of the continuous strip mill rolling process and other pioneer contributions.

In addition to the continuous rolling mill, members and guests will see many other manufacturing operations, such as galvanizing, production of spiral welded pipe, and the finishing of stainless steel plates and sheets. A visit will also be made to the research laboratories adjacent to the plant.

At the conclusion of the inspection, members of the party will be the guests of the company at dinner.

Following dinner, the group will return by bus to Cincinnati.

Tickets for the trip are $2.00 each.

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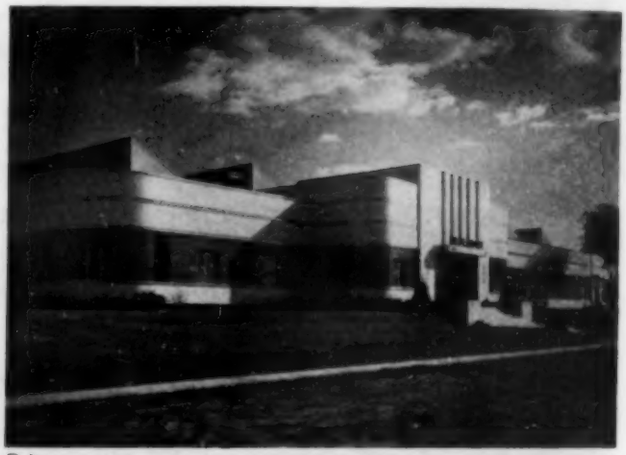
COLD ROLLING MILL—ARMCO PLANT



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ARMCO'S NEW RESEARCH BUILDING

Entertainment for the Ladies

WEDNESDAY—October 16, 1940

Afternoon

1:00 Luncheon, Restaurant Continentale, Netherland Plaza

Tickets for the luncheon, $1.50 each.

2:00 Special Tour for the Ladies

After the luncheon, the ladies will have the choice of a number of visits to places of cultural interest, all within a short distance of the hotel. The places selected of particular interest to ladies are as follows:

Taft Museum, Inclined Plane to Mt. Adams, Rookwood Pottery, Krohn Flower Conservatory, Cincinnati Art Museum.

Tickets for the tour are $1.50 each

Evening

Dinner, Entertainment, Dancing

7:15 Dinner and Entertainment

Address, "The Function of the City," by COL. WILLARD T. CHEVALIER.

Social Hour

Dancing, Continentale Room

Tickets for the dinner and evening's entertainment are $2.50 each.

THURSDAY—October 17, 1940

Afternoon

12:30 Bridge Luncheon at Hamilton County Country Club

Ladies will leave the hotel entrance by bus at 12:30 p.m for the country club.

Following the luncheon, the afternoon will be free for cards or other entertainment.

Tickets, $1.50 each.

Evening

7:15 Dinner and Entertainment, The Pavillon Caprice

Address, "Glaciers Over Cincinnati," by DR. NEVIN M. FENNEMAN, *Professor of Geology, Univ. of Cincinnati.*

Dancing, Continentale Room

Tickets for the dinner and evening's entertainment are $2.50 each.

FRIDAY—October 18, 1940

Afternoon

2:45 Cincinnati Symphony Orchestra Concert

RUTH POSSELT, *Violin Soloist*

Tickets for the concert are $2.00 each.

Ladies who prefer, may join members on the trip to the American Rolling Mills Company at Middletown, Ohio, which starts from the hotel at 1:00 p.m.

Announcements and Hotel Accommodations

Order All Tickets in Advance

Members who order tickets in advance not only will be saved delay by having tickets and badges awaiting them on arrival at headquarters, but they will assist the committee greatly by giving advance information to guide it in concluding arrangements.

See page 28 of Advertising Section for Ticket Order Blank.

Registration Desk and Information

A registration desk will be provided in the headquarters hotel to assist visiting members in securing desired information about the city. At the registration desk a card file of those in attendance will be maintained, with information as to Cincinnati addresses.

Golf

Members and guests will be welcome to use the golf and riding facilities at the 36-hole Kenwood Country Club, scene of the 1933 National Amateur Championship matches. Introduction cards will be issued at the meeting registration desk at nominal fees.

Entertainment for the Ladies

Attention is directed to the entertainment provided for the ladies. It is expected that they will participate with the members in any other features of the program in which they are interested.

DESCRIPTION OF POINTS OF INTEREST ON LADIES' TOUR ON WEDNESDAY, OCTOBER 16, 1940

The Taft Museum

The century-old tradition of culture and hospitality that surrounded the house as a private dwelling from its erection in 1820, is maintained under endowment by the Cincinnati Institute of Fine Arts. Although small, its collection rivals in quality that of many a larger and more celebrated museum. A magnificent series of portraits and landscapes by such masters as Rembrandt, Turner, Goya, Gainsborough, and Corot; French Renaissance painted enamel placques and dishes, jewelry and watches from many countries, and many Chinese porcelains are installed in a beautifully decorated period house, which in itself with its furnishings, merits the visitor's attention for its charm and authenticity.

The Rookwood Pottery

The Pottery was founded in 1880 by Mrs. Maria Longworth Storer, who named it Rookwood after her father's country estate near the city. It is managed under a trusteeship, obligated to perpetuate the policy which has given Rookwood its unusual character as an art industry. The Pottery is managed on lines contrary to the prevailing factory system, as the effort is to attain a higher art, rather than commercial output. A spirit of freedom and liberality has prevailed in order to cultivate in every way individual artistic feeling among the workers employed. The decorators comprise both men and women, and are drawn mainly from Cincinnati. Rookwood pottery has won fame, recognition, and honors all over the world for its unique and artistic character.

The Cincinnati Art Museum

The Museum is the city's pride as its cultural high spot. A collection of old masters, including Mantegna, Titian, Rembrandt, Hals, Van Dyck, Velasquez, El Greco, Murillo, Zurbaran, Gainsborough, and Raeburn has brought international fame to the Museum. American artists, like Stuart, Homer, Whistler, Cassatt, Sargent, Duveneck, and Twachtman are represented by excellent examples. Other outstanding features are: Cincinnati interiors of a century ago, the arts of the American Indian, a large and active print department, and a full schedule of temporary exhibitions.

The Irvin M. Krohn Conservatory

Situated in the hills in Eden Park, the Conservatory is a modern and delightfully equipped flower and plant show place. Beautiful collections of local blossoms and tropical plants are always on display.

The Mt. Adams Inclined-Plane Railway

Cincinnati is one of the few cities which still has an inclined plane to raise traffic from the lower to the upper level of the city. The ride up the plane is in great demand by visitors to the city. An inspiring view of the entire downtown area and of the Ohio River valley is gained from the bus seat during the ascent.

Hotel Rates, Cincinnati Hotels

Hotel	Single Rooms		Double Rooms	
	With Bath	Without Bath	With Bath	Without Bath
Netherland Plaza	$3.00 up	...	$5.50 up	...
Gibson	2.50 up	...	4.00 up	...
Sinton	3.00 up	...	4.50 up	...
Metropole	2.50 up	$1.75	3.50 up	...
Parkview	2.50 up	...	3.50 up	...

The Hotel Netherland Plaza is the Society headquarters for the Fall Meeting.

Members are urged to make definite arrangements for rooms at least a week in advance of the Fall Meeting, paying for the rooms in advance for at least part of the period for which they expect to be in Cincinnati.

All who attend the Fall Meeting are requested to register immediately upon arrival at meeting headquarters. Special badges and tickets will be obtained at the time of registration.

Program of Student Chapter Conference

Wednesday and Thursday, October 16 and 17, 1940, at Hotel Netherland Plaza

WEDNESDAY—October 16, 1940

Morning

9:00 **Registration**

10:10 **General Meeting**

12:15 **Luncheon**

Afternoon

JOHN A. DIEHL, *President, University of Cincinnati Student Chapter, Am. Soc. C.E., Presiding*

2:00 **Session of Student Chapters called to order**
Address of Welcome
JOHN H. PORTER, *M. Am. Soc. C.E., Consulting Engineer,* St. Louis, Mo.; *Member, Society Committee on Student Chapters.*

2:15 **Speakers**
E. M. HASTINGS, *M. Am. Soc. C.E., Chief Engineer, R.F. & P.R.R.,* Richmond, Va. "What Lies Ahead in Engineering."
CLYDE T. MORRIS, *M. Am. Soc. C.E., Professor of Civil Engineering, Ohio State University,* Columbus, Ohio. (Title to be announced.)

3:15 **Discussion**

Evening

6:15 **Dinner at Campus Y.M.C.A.**

9:00 **Informal Dance at Y.M.C.A.**

THURSDAY—October 17, 1940

At University of Cincinnati

Morning

CHARLES R. NUCKOLLS, *President, North Central Student Conference, Am. Soc. C.E., Presiding*

9:00 **North Central Student Conference called to order**

9:10 **Student Papers**—Limited to about 2,000 words each from Chapters who are active members of North Central Conference

11:00 **Discussion**

11:30 **Report of Executive Committee**
Election of Officers for 1941–1942

12:15 **Luncheon, Rooms 307–8–9, Student Union Building**

Afternoon

Inspection trips

Announcements and Committees

Local Sections Conference, Tuesday, October 15, 1940

A conference of representatives of Local Sections will meet at 9:30 a.m. on Tuesday, October 15, 1940, at the Hotel Netherland Plaza. The program will schedule topics of professional rather than technical interest, in which all representatives are expected to participate. All members of the Society are welcome to attend.

Student Conference, Wednesday and Thursday, October 16 and 17, 1940

Members of Student Chapters are invited to participate in all events of the Fall Meeting. Particular attention is called to the program of events in the Student Conference on Wednesday and Thursday, October 16 and 17, 1940.

LOCAL COMMITTEES ON ARRANGEMENTS

Advisory Committee

Cleveland Section	C. H. SPLITSTONE
Central Ohio Section	F. H. WARING
Dayton Section	F. J. CELLARIUS
Indiana Section	L. E. MARTIN
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Student Chapter Conference

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H. C. DOVERSPIKE	R. W. RENN	W. B. WARD
F. R. JONES	C. F. RENZ	A. M. WESTENHOFF
R. H. MERKEL	C. O. SHERRILL	S. C. WESTERFELD
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Ladies Reception Committee

MRS. H. H. SCHROTH, *Chairman*

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MRS. R. A. ANDEREGG	MRS. E. H. MARKS
MRS. H. F. ANDERSON	MRS. H. S. MARSHALL
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MRS. H. B. LUTHER	MRS. CHARLES WUEST, JR.
MRS. O. T. YATES	

The program as a whole has been prepared under the direction of the Fall Meeting Committee, composed of R. P. DAVIS, Vice-President, Am. Soc. C.E., Chairman, and EDWARD S. BRES, ARTHUR W. HARRINGTON, CLARENCE M. BLAIR, and JOSEPH E. ROOT, Directors, Am. Soc. C.E.

Please call on the Local Committee on Arrangements or on the Secretary's office for any service desired.

To Commemorate An Anniversary

"CIVIL ENGINEERING" WAS INAUGURATED OCTOBER 1, 1930

After Ten Years

WITH something of a shock I realize it was ten years ago that I was privileged as President of the Society to endorse a foreword for the first issue of CIVIL ENGINEERING. Possibly a worse time than 1930 could hardly have been chosen to inaugurate such a new project. How fortunate that we cannot see far ahead! Certainly if the extent of depression could have been forecast, the beginning of CIVIL ENGINEERING might well have been deferred, perhaps forever.

But it is equally certain that with the benefit of "hindsight" we can re-assess the facts. And in so doing we are bound to assure ourselves that the new publication venture was one of the soundest, most worth while, that the Society could have undertaken.

I must confess that I, with other thoughtful members, had some inner doubts. The Society's high ideals, its dignified reputation, its avoidance of commercialism—could these be safeguarded in a semi-popular publication? Could they be maintained and enhanced? These were critical questions. In the end the Board of Direction resolved any misgivings in view of its confidence in its valuable Committee on Publications. The red light of doubt gave way to the yellow of caution, and this in turn changed to the green of whole-hearted advance.

Prophecy is always dangerous and those foolhardy enough to indulge in it inwardly hope no one will check up on its fulfilment. But as I read again my foreword of ten years ago, I see no reason to retract or to qualify. Instead, my convictions are strengthened that the magazine has actually been "a great progressive step" and that in the light of retrospection it has indeed had "the unqualified general approval of the membership."

For the future, I am convinced it will continue to deserve and to receive the generous support of the Society.

J. G. Coleman

HON. M. AM. SOC. C.E.
PRESIDENT OF THE SOCIETY IN 1930

Looking Forward

WE all remember when there was no CIVIL ENGINEERING, though some held it as an idea, a dream. It was not tangible and could be imagined only vaguely. What might it be like and how might it serve the Society? I was not a member of the Board of Direction at that time; therefore I can take no credit for its institution. I wish I could.

As President at the time of this anniversary, however, I think I can gage the pulse and tempo of the Society from intensive contact with its problems and extensive contact with its membership. And I think I can foresee at least some of the possibilities that lie ahead, based on the ten years that are behind. This is a much simpler problem of forecasting than was that which President Coleman faced under similar circumstances ten years ago. At least, we now have experience as a guide.

I foresee, then, that CIVIL ENGINEERING will continue to be a useful medium for recording what the profession and what the Society are doing. New things will be done that we should all know about; new ways will be found for doing old things, for doing them better, or quicker, or cheaper. The days to come are critical for our nation and every engineer will want to be aware of progress in what the profession is thinking and doing. This publication will keep him in touch with the best.

Officers and staff can take justifiable pride in CIVIL ENGINEERING. But, after all, they only utilize what others have supplied. It is the authors, principally, who make each issue what it is; and these are mainly you members. So to you I say, take your Society publication to heart; contribute of your perplexities, your researches, your successes, your failures and their rectification. Thus both you and the profession will gain.

John P. Hogan

M. AM. SOC. C.E.
PRESIDENT OF THE SOCIETY IN 1940

SOCIETY AFFAIRS

Official and Semi-Official

A Time for Review

By T. R. Agg, M. Am. Soc. C.E.

Chairman of the Society's Committee on Publications

In this, the October 1940 issue, we reach the tenth anniversary of Civil Engineering. One period ends, and another begins. We pause, if only for a few moments, to take an account of stock. If we can do so in a detached manner, so much the better. That is, perhaps we can "step aside and see ourselves go by."

There are many ways of measuring abstract growth. But there is no convenient way to measure the growth in influence and usefullness during a period of ten years of a publication such as Civil Engineering. In fact, it is hard to distinguish in detail between the first number in October 1930 and the present issue.

The simple truth seems to be that the magazine appeared on the scene almost full grown. Changes have been in detail, not in principle. Evidences of greater maturity are now to be found if one hunts for them, but the character is the character of October 1930. Investigation would demonstrate that the format, the type face, the general text treatment, are about the same. A slight change in trim size has been made to agree with the standards adopted for many similar magazines, but the alteration is so slight as to be hardly noticeable.

In some essentials there has been improvement. Starting in February 1937 the Committee on Publications decided to sponsor a series of philosophical treatments of professional matters, for which two pages at the beginning of the reading section were reserved. These pages bear the general heading, "Something to Think About," and have been a popular part of each succeeding number. At the other end of the text, a department covering "Equipment, Materials, and Methods" has also been added to emphasize and illustrate the progress of manufactured articles of use to civil engineers.

Announcements of the Society's quarterly meetings, with all details of technical papers and social events, were formerly distributed individually to members. After study, these official programs were found to be suitable for inclusion in the new publication and the change was effected. As a result, considerable expense has been saved and the programs, forming as they do a record both of Society and of technical progress, are more permanently preserved.

Shortly after Civil Engineering was founded, it became evident that it was an ideal medium for making available to the membership the technical content of Society meetings. Thereafter, four issues a year were more or less monopolized by material from such technical papers. But as the Society meetings grew, in step with the development of the Divisions, these quarterly meeting issues tended to get out of balance in point of size. So the articles from a Society meeting came to be spread over a number of issues, some appearing before and some after the quarterly meeting from which they originated.

As a result, the various monthly issues of Civil Engineering are now quite uniform, with about 35 pages of main articles, which average ten or more per issue. Such a quantity of material each month makes it possible to cater to the wide variety of interests among readers. In terms of types of projects—such as sanitation or transportation—each number includes from five to nine separate topics. Another variation of content concerns the "functional" classification—such as economics or construction. Of seven such classes, an average of five and one-half are served by each issue. This variety of coverage, combined with the high type of authorship of the main articles, insures that every member when he picks up this Society journal, should find a number of articles of interest and value to him.

Significance attaches to the source of the articles. In round figures, 40% originate from Society meetings; 30% are contributed voluntarily; 20% are solicited for specific purposes; and 10% result from Section meetings throughout the country.

Certain articles have geographic significance, either because of their origin or because of their subject matter. During the year, every part of the country is represented. It is notable, however, that special interest has been shown within a broad band extending from Connecticut through the Tennessee Valley and Texas to California; three-quarters of the papers have been related to this area while the remaining one-quarter have been distributed over the northern part of the country and the Southeast.

Other significant data on Civil Engineering for the year 1939 give 170 items in Society Affairs, 330 reports of Local Section meetings, 140 accounts of Student Chapter activities, 350 references in "News of Engineers," 180 employment notices and a similar number of obituaries, and 1,250 listings of current periodical literature. In order to serve the best interest of members, particularly readers, the Committee on Publications has long enforced a limitation of four pages on main articles and six hundred words on letters to the editor.

As an advertising medium Civil Engineering has progressed steadily. The advertising pages carry, year after year, the campaigns of the leaders in the manufacture of engineering materials and construction equipment. The rate of growth of the advertising volume has exceeded the gains recorded by the average of 108 other technical and industrial publications during the past ten years. The effectiveness of the publication has been confirmed repeatedly. In the issue of January 1940, a half-page advertisement produced over 937 keyed responses. Since this represents a return from approximately 6% of the total circulation of the publication, it indicates that Civil Engineering is establishing for itself a position of leadership among periodicals in the civil engineering profession and its allied interests.

What does all this sum up to? It indicates a new emphasis, a wider field, a more intensive cultivation over ten years. It is part of a carefully considered

Forecast for October "Proceedings"

The Grand Central Terminal in Perspective

By William J. Wilgus, Hon. M. Am. Soc. C.E.

An exposition of the inception, development, and quickening of a complete engineering development, the Grand Central Terminal, New York, N.Y.

Earthquake Stresses in the San Francisco–Oakland Bay Bridge

By Norman C. Raab, M. Am. Soc. C.E., and Howard C. Wood, Assoc. M. Am. Soc. C.E.

Review of the design, including some unusual problems encountered in computing earthquake stresses, further clarified by vibration measurements on the finished structures.

Transatlantic Seaplane Base, Baltimore, Md.

By W. Watters Pagon, M. Am. Soc. C.E.

Describes unusual and difficult foundation conditions and an extraordinary hangar design dictated by those conditions.

effort to make the Society more useful to its members. It evidences the greater attention that is continuously being paid to the work of the Local Sections; to the status, the work, and the future of the Juniors; to the increasing attempts to wield a helpful influence in the economic status of the membership. All this has been built on top of the Society's regular program designed to bring the best in technical progress to members regularly through PROCEEDINGS. With its freer, more flexible format, CIVIL ENGINEERING has added a medium for bringing quickly to the membership at large matters of interest and value, frequently involving the time element.

That the publication has satisfied such a need and that it is admirably serving its purpose is being constantly brought to the attention of the Committee on Publications. In an organization that is almost ninety years old, ten years is not a long period. But it is long enough, especially ten such years as have just been experienced, to demonstrate the worth and vitality of a new venture such as CIVIL ENGINEERING. Its place as an essential element in Society activities is secure.

Society Assistance to Employed Engineers re Salaries and Working Conditions

FOR SOME TIME there has been under advisement a method whereby the Society might lend material assistance in cases where numbers of engineers felt the need of improving their economic circumstances. The project was brought to the attention of the Board at its Denver meeting in July. It has also received extensive study by Director E. P. Goodrich, former chairman of the Committee on Salaries, and has been reviewed by Dean G. Edwards, present chairman. As approved by the Board in Denver, on July 23, these regulations provide as follows:

Scope

(*a*) The American Society of Civil Engineers will undertake to assist groups of engineers in endeavors to secure adjustments in salaries and working conditions.

(*b*) Such assistance will be limited to groups who give evidence of full cooperation in the undertaking.

(*c*) Such assistance will not extend to action at law.

(*d*) The undertaking of such assistance will indicate, in no sense, any guarantee of a satisfactory outcome.

(*e*) The right is reserved to discontinue, without explanation, any course of action undertaken.

Procedure

(*a*) Cases shall originate with a petition signed by a majority of those affected or may be originated by a request of the Board of Directors of the Local Section most intimately related to the affected group.

(*b*) If the petition emanates from an affected group, it shall be addressed to the Board of Directors of the Local Section most intimately related to the group and shall be supplemented by a request from the Board of Directors of that Local Section.

(*c*) Such petition, or request, shall be accompanied by a statement of the conditions sought to be adjusted, the adjustments sought, and evidence of need for adjustments.

(*d*) Decision as to whether or not action will be taken shall be made by the Executive Committee of the Society.

(*e*) Action will be taken only if the affected group or the Local Section most intimately related to that group shall contribute a share of the cost of the undertaking as may be decided by the Executive Committee of the Society jointly with the Board of Directors of the Local Section making the request.

(*f*) Publicity, negotiations with employers, and all other matters of policy or action shall be as determined in each case by the Executive Committee of the Society.

Freeman Scholar Plans Itinerary

AS THE FIRST Freeman Scholar to undertake his year of hydraulic study within the confines of the United States, Haywood G. Dewey, Jr., Jun. Am. Soc. C.E., was expected to begin his work on September 30 with a two-week visit at the Iowa Institute of Hydraulic Research. From there his itinerary carries him gradually eastward to the Atlantic seaboard, then south and west across the continent, up the west coast, and finally back to Denver on June 30, 1941.

Other visits of two weeks or more during the course of his study will be at the University of Minnesota, the schools in the New York metropolitan area, the National Hydraulic Laboratory, the Tennessee Valley Authority, the U.S. Waterways Experiment Station, and various projects of the Bureau of Reclamation. Briefer calls will include some twenty other university laboratories, Engineer Corps offices, and miscellaneous hydraulic structures.

TRANSACTIONS for 1940 Has Important Additions

ON OCTOBER 15 the 1940 TRANSACTIONS makes its appearance. Paper volumes will reach members by mail in the same carton as PROCEEDINGS and will be designated as PROCEEDINGS, Part 2. Copies in cloth and half morocco bindings will be sent out somewhat later, by separate mailing.

TRANSACTIONS will contain as much new material for study as in former years. In addition to the Wind Bracing Report, noted in another item, the ten-year summary report of the Committee on Water Supply Engineering of the Sanitary Engineering Division deserves a hearty vote of approval. Under the tireless leadership of its chairman, Thomas H. Wiggin, M. Am. Soc. C.E., the scope of this concise 42-page report is almost that of a handbook. Certainly it is that in the sense that various chapters were assigned to experts in their various lines, several being by engineers outside the committee, including two who are not members. The committee is composed of F. A. Barbour, J. R. Baylis, W. W. Brush, L. R. Howson, and J. A. Wade, Members Am. Soc. C.E. In an all too inadequate paragraph of acknowledgment they give credit to Prof. Robert W. Angas (section on water hammer), Frederick W. Scheidenhelm, M. Am. Soc. C.E. (section on masonry dams), W. P. Creager and J. D. Justin, Members Am. Soc. C.E. (section on earth dams), Frederick H. Fowler, M. Am. Soc. C.E. (section on rock-fill dams), and Henry Horandt (section on meters).

The President addressed the membership on the subject of the role of the Society in national defense in his annual address given this year at Denver, Colo. An abstract of this important address was published in CIVIL ENGINEERING, but the complete document appears for the first time in Vol. 105 of TRANSACTIONS. Also included are memoirs of 104 deceased members and the usual number of closing discussions received too late for prior publication in PROCEEDINGS. All those who are interested will find such discussions by reference to the author or subject indexes.

District 7 Holds Third Annual Convention

MEMBERS of the Society living in District 7—comprising Michigan, Wisconsin, Minnesota, the Dakotas, eastern Montana, and adjacent parts of Canada—held their third annual convention in Milwaukee, Thursday to Saturday, August 22 to 24. Golf at the North Shore Country Club Thursday afternoon was followed by a dinner at the club. The principal after-dinner speaker was Walther Richter, consulting engineer of Milwaukee, whose subject was "A Journey Through Germany, Austria, and Switzerland in 1939."

The convention was welcomed Friday morning by Walter Anderson Peirce, former president of the Wisconsin Section, and A. J. Duvall, president of the Northwestern Section, responded. During the business session that followed Gordon Butler was elected president of the District organization for the coming year. Others selected were George R. Thompson and Frederick Bass, vice-presidents, and Bernard D. Keatts, secretary. In the afternoon William N. Carey, chairman of the executive committee of the Highway Division of the Society, emphasizing the role of the engineer in building military roads, spoke on "The Highway Committee's Place in National Defense." Later William M. White discussed Local Section programs.

The feature of the annual dinner, held that evening at the Hotel Pfister, was a talk on "Current Rackets Affecting Consumers," by Richard Jordan, manager of the Milwaukee Better Business Bureau.

Tours of the new water-filtration plant and the residential and downtown districts of the city, which took place on Saturday morning, concluded the meeting. Louis J. Larson, who was in charge of arrangements, reports an interesting and enthusiastic session.

National Defense Construction Progresses

A CURRENTLY important item of federal legislation is the recent appropriation by Congress of another five billion dollars for national defense. This brings the total of the defense appropriations to over fifteen billions of dollars. This bill, called the Second Supplementary National Defense Appropriation Act 1941 (Public No. 781) passed Congress August 29 and received the signature of the President on September 9, 1940. The major items of appropriation are: one and one-half billion dollars to the Army Air Corps; two hundred million dollars for the construction and installation of buildings and flying fields at military posts; one and one-half billion dollars for Army Ordnance service and supply; two hundred thirty-five million for government-owned facilities and land at privately owned plants, and for training civilian personnel for plants producing defense equipment and material for the Army; five hundred and fifty-five million for the purchase of Navy aircraft and the expansion of private plants manufacturing them; three hundred sixty-five million for ship maintenance, replacement, and armament; one hundred million for military, naval, and industrial defense housing; fifty million for Navy public works by the Bureau of Yards and Docks; and other miscellaneous smaller items to make up a total of slightly over five billions of dollars.

In this bill also is a provision giving to the Secretary of War discretion until June 30, 1942, to "allocate to the Corps of Engineers any of the construction works required to carry out the National Defense Program" and to transfer to the Corps the "funds necessary to execute the works so allocated."

The call of the National Guard and Reserve Corps to active training, and the approval of the universal selective service training act on September 16, have resulted in clarifying defense construction needs. The passage of the Supplementary Appropriation Act has provided the additional funds required to proceed.

The construction of facilities for national defense are now under way by the Navy Bureau of Yards and Docks, of which Rear-Admiral Ben Moreell, M. Am. Soc. C.E., is the chief; and by the Construction Division of the Office of the Quartermaster General of the Army, of which Brigadier-General Charles D. Hartman is chief. The acts of Congress which authorized appropriation to the Navy are different from those concerning the Army. The contract forms, procedures, and the methods of selecting engineering firms, and the construction firms also differ. The fundamental purposes behind the push for the construction of facilities for national defense however are the same.

The present national emergency requires prompt initiation and rapid, economical completion of the Defense Construction Program. There is no time to prepare the detailed plans and specifications which are required by the established and normal competitive bidding procedure prior to the award of government contracts. During World War No. 1, the Government entered into numerous emergency cost-plus-a-per cent-of-cost contracts in order to save time, but Congress has since made this form of contract illegal for Army construction. The Bureau of Yards and Docks, however, has given extended study to executing work on a cost-plus-fixed-fee basis. The fee in a cost-plus-fixed-fee contract is not affected by variations in cost and there is no advantage to the contractor in increasing the cost of the project. During the past fiscal year, the Bureau of Yards and Docks has awarded fifty or more construction contracts on a cost-plus-fixed-fee basis, and in addition has awarded about the same number of contracts for engineering and architectural services on this basis.

QUARTERMASTER CONSTRUCTION

During the past several months, the Construction Quartermaster has developed a form of cost-plus-fixed-fee contract for contractors and subcontractors and another form for professional engineering and architectural services. Contracts on this basis are now being negotiated by the Quartermaster. Under the cost-plus-fixed-fee method of doing construction work, the close cooperative effort of three parties resident on the job are required: first, a contracting officer or a construction quartermaster representing the Government and having power to make decisions in all matters on design, construction, and finance; second, a combination of engineering and architectural firms to do the necessary designing, planning, and the supervision of the construction work; and third, a contractor to do all the construction work. The successful operation of this team requires a high degree of mutual confidence and understanding.

The same contract form, and a common basis for the fixed fees to be paid are to be used for both engineering and for architectural service. When both engineering and architectural services are required on a project, the engineer and architect will be asked to join in the same contract. It is intended that only one contract for professional services will be necessary for each project; and that the professional contract will be entirely separate from the construction contract. The size of the contracts will be large—five to ten million dollars each.

As to the form of contract prepared by the Construction Division of the Quartermaster Corps for engineering and architectural services, close study has been given to this by a joint committee of the Society and the American Institute of Architects. The committee's opinion is that the conditions, the terms, and the scope of the work to be performed by the engineer, or the architect, and the character of the costs to be paid by the Government, are clearly and fairly set forth in the document; that they are fair to both the profession and the Government; and that it is a contract that engineers and architects should be willing to sign.

In the contract are three important blanks to be filled in for each project by the Quartermaster General: (1) an estimated construction cost, (2) an estimated time to construct, and (3) the amount of the fixed fee. If the scope of the work contemplated is changed materially during its progress for any reason, an equitable adjustment is proposed to be made in the amount of the fixed fee. Should the time of construction extend for more than a month beyond the time limit estimated in the contract, an equitable adjustment is proposed to be made in the amount of the fixed fee.

The contract contemplates that a field office be established on the site; and that all direct costs for salaries, services, materials, equipment and facilities of every kind and nature be included in the costs to be paid by the Government, except that the full time of a resident partner or principal of the engineer or architect, or an officer of the corporation if the engineering and architectural firms incorporate, or a personal representative of the firm acceptable to the Government, is to be devoted to the work at the cost of the engineer-architect. No item of indirect head-office overhead is included in the costs to be paid by the Government.

The Government proposes in this form of contract to save the engineer from risk due to financing, to changes in plans or changes in time to complete the work, or to other causes. In effect, the contract becomes a management contract providing for the full services of a partner of the firm, for the duration of the project, to direct and manage the professional and technical services that are to be rendered at Government cost, and to be the Government's consultant for the duration of the project. For this management service, a fixed fee is to be paid. The fee is established by the Quartermaster in charge of construction for each project before negotiations are begun with the professional firm selected to perform the design and supervision service.

Speed is the principal activating motive behind each project. The estimated rate of construction expenditures on each job is at one million dollars per month or faster. The amount of the fixed fee is less than the standard for normal civil work with a private owner, but the service to be rendered is less meticulous, less inclusive, and will cover a much shorter period of time than in normal private work.

Although the proposed total expenditures for defense loom large (15 billion dollars) the amount that will go into direct government construction does not now appear to be more than was expended annually in the PWA program, now being liquidated. It is also indicated in a release from the Quartermaster General's office (CIVIL ENGINEERING, September 1940, page 602) that it has already more personnel data than it now expects to make use of.

CENSUS QUESTIONNAIRES

The questionnaire forms returned to Society Headquarters at the request of the National Committee on Construction Preparedness have been made available to the Construction Quartermaster of the Army and to the Chief of the Bureau of Yards and Docks of the Navy. It is understood that these records are being used and are a valuable aid in the selection of engineering firms to

undertake immediate service in the defense construction program. These records are being made available to other Government agencies in Washington as need develops.

DEFENSE HOUSING BECOMING ACTIVE

In the Second Supplementary National Defense Appropriation Act, which became law on September 9, appears an item of one hundred million dollars for military, naval, and industrial defense housing. This amount has been placed in the hands of the President for allocation to the War Department and the Navy Department. The average unit cost, including acquisition of the land and the necessary utilities, is not to exceed $3,500. When completed, the housing units are to be made available on a rental basis to enlisted men of the Army, Navy and Marine Corps and their families, to field employees of the Government, and to workers with families engaged by industries who are turning out material and equipment for national defense.

There is pending in Congress also a bill sponsored by Defense Housing Coordinator C. F. Palmer, appropriating one hundred and fifty million dollars to provide housing for persons engaged in national defense activities, wherever the President finds that an acute shortage of housing exists which would impede the national defense activity. The bill provides that the work be done by the Federal Works Agency. As of September 22, this bill (H. R. 10412) had passed the House and was on the Senate calender.

The needs for housing as reported to the office of the Defense Housing Coordinator up to September 10, include 109,555 units. In addition the Army needs a total of 40,000 dwelling units. The immediate volume of industrial defense housing in the larger cities is not yet known and reported. The ultimate size of the defense housing program can be visualized by comparing the reported total needs with the 27,300 units to be taken care of by the $100,000,000 allocation for military, naval, and industrial defense housing contained in the Second Supplemental National Defense Appropriation Act.

On September 21 a special military housing appropriation bill went from the Senate to the White House for approval. This provides $338,000,000 for barracks and tent platforms to house the half-million men arriving for training after the middle of November.

Especially in established communities, it is anticipated that private capital can be interested in providing defense housing. The Government, through FHA, will insure loans made by local banks to construct such housing facilities. The USHA, which has been loaning funds to local housing authorities for slum clearance projects, has been authorized by law to undertake defense housing projects also and has several such projects under way at present.

Where neither private capital nor local housing authorities can be interested in the needed housing program, the Government will be required to engage in direct construction of the temporary houses required, either through the Army, the Navy, or the Federal Works Agency.

RECOMMENDATIONS MADE

Acting jointly, John P. Hogan, President of the Society, Edwin Bergstrom, president of the American Institute of Architects, and A. D. Taylor, president of the American Society of Landscape Architects, have recommended to the Administrator of the Federal Works Agency, as follows: (1) that defense housing projects be placed under a federal agency responsible for the general direction of the project and a general policy; (2) that a federal representative resident on the work be empowered to make decisions relating to the projects; (3) that qualified architects, civil engineers, and landscape architects resident near the project, be employed on a lump sum or a cost-plus-fixed-fee form of contract to collaborate and furnish the design services and to supervise the construction; and (4) that a field office be set up on or near each project to perform the necessary design and supervision services. It was recommended also that the contract for engineering services be based on a cost-plus-fixed-fee form adopted by the Quartermaster Corps.

That part of the defense housing program which may be handled by local housing authorities will require the employment of engineering and architectural service by the Authority rather than by the Government itself. Here again speed will be the vital element and the present procedure heretofore recommended by USHA to the local housing authorities for the employment of professional technical men in the field of architecture, engineering, and landscape architecture, will require modification in order to expedite the work.

CONSTRUCTION QUARTERMASTER APPOINTMENTS

Local Sections of the Society have cooperated magnificently in supplying the names of qualified engineers who may be selected by the Quartermaster General to assist in carrying out his program. To date some 1,200 names have been submitted and many direct applications have been made. Perhaps 100 to 200 construction quartermaster officers, probably with the grade of major, will be needed, each with a competent staff of officers and civilian employees. The number of commissioned officers may be as many as one for each million dollars of work under construction. Officers are being selected as they are needed, first preference being given to those who now have reserve commissions, and who are able to pass the rigid physical examination required for active service in the Army. The Quartermaster General now has on file the records of more than will be needed for this purpose.

AIRPORT CONSTRUCTION

In addition to the Army and Navy airdromes, Col. Donald H. Connolly, M. Am. Soc. C.E., Administrator of the Civil Aeronautics Authority, has prepared a six-year plan for the expansion of existing airport facilities throughout the country to a network of 4,000 civil fields for both military and civilian purposes. The six-year plan, estimated to cost five hundred and sixty million dollars, provides for the increase of major civil airports from 36 to 500; of medium airports from 250 to 1,600; and of smaller fields from 1,600 to 1,900. The Authority has developed engineering plans for the improvement of 600 or more of these.

A start on this comprehensive program is to be made with a request to Congress for an initial eighty-million-dollar allocation for this fiscal year. The agencies for carrying out the design and construction of these additional landing fields have not been selected.

STRATEGIC HIGHWAYS

For primary highways in the Federal Aid system, Congress has made one hundred million dollars available to be matched by the separate state highway departments during the fiscal year beginning July 1, 1941. This, together with the funds already available and unobligated, makes it possible to begin planning and construction of a strategic network of highways.

A recent re-study of highway needs for defense purposes includes 75,000 miles of highway in the network. Many miles of this network are now in condition for military use. But the Federal Highway Act of 1940, approved September 5 by the President, provides as follows: "In approving Federal-Aid highway projects to be carried out with any unobligated funds apportioned to any state, the Commissioner of Public Roads may give priority of approval to, and expedite the construction of, projects that are recommended by the appropriate Federal defense agency as important to the national defense."

The greatest needs are: to strengthen an estimated 1,800 bridges to carry H-15 loading; to modernize curves, grades, and road surfaces; and to widen shoulders to a minimum of 8 ft to provide parking and passing of military trains. The Public Roads Administration is studying the specific requirements, the cost, and the period of time over which the program can be accomplished. A report is expected during October. An idea of the magnitude of this program can be obtained from the estimate prepared January 1, 1940, before the defense program was initiated, by the American Association of State Highway Officials. This report estimated nearly four billion dollars for rebuilding, relocating, and widening 106,560 miles of road and widening or rebuilding 21,680 bridges.

ROSTER OF SCIENTIFIC AND SPECIALIZED PERSONNEL

Directly under the President has been instituted a national Roster of Scientific and Specialized Personnel administered jointly by the National Resources Board and the Civil Service Commission with Dr. Leonard Carmichael, president of Tufts College, as director, and James C. O'Brien of the Commission as executive secretary.

Four cooperating agencies are the National Council on Education, American Council of Learned Societies, National Research Council, and the Social Science Research Council. The National Research Council's field is that of science and technology, and Dr. John S. Nicholas, Sterling Professor of Biology, Yale University, has been designated as the representative of the Council on the National Roster Committee. Assisting Dr. Nicholas will be

an Evaluation Committee in the field of engineering, two members of which are the President and the Secretary of the Society, Colonel Hogan and Mr. Seabury. Other members are Dr. H. A. Poillon, acting chairman, and Dr. F. M. Feiker, Dr. Maurice Holland, and Dr. F. G. Cottrell.

For the engineering element of this roster a group composed of the secretaries of 13 associations of engineers met in the board room of the Society's Headquarters on Friday, September 6, 1940, to determine how best could be obtained a list of engineers who would be circularized to ascertain the nature and extent of their special technical competence.

It was agreed that all the associations represented would supply lists of their members either totally, on the basis of the respective grades in each association, or after some degree of selectivity in relation to the purposes of the roster. Upon advice as to the form in which the lists are desired, they are to go forward, probably in duplicate. Each Corporate Member of the Society resident in the United States or Canada therefore should expect to receive a questionnaire shortly. Before Christmas similar lists of the Society's Juniors are to be made available. It is greatly hoped that these questionnaires, when received, will be accepted and answered both thoughtfully and promptly.

Each association also agreed to prepare a "technical check list" showing the special scientific, technical, or administrative functions to be found in its branch of engineering. The check list for the civil engineers, prepared at Headquarters, indicates 176 types of technical skill, in design, inspection, construction, management, and economics.

Donald P. Barnes Assumes Editorship

WITH THIS, the tenth anniversary number of CIVIL ENGINEERING, Donald P. Barnes, Assoc. M. Am. Soc. C.E., takes over his new duties as editor. Originally it was planned that this change should have taken place in July, but other requirements, particularly an assignment with the Officers Reserve, have delayed the beginning of his new work.

Although Mr. Barnes is only in his early thirties, he has a good background of academic work and engineering experience. His undergraduate course in engineering was at Oregon State College, which was followed by studies leading to a master's degree in connection with a teaching fellowship at the California Institute of Technology, where he majored in structural engineering. In due course he became Freeman Scholar for the Society in 1932–1933, during which time he audited courses at both Berlin and Karlsruhe universities. Prior to his year in Germany, he taught structural subjects at the Missouri School of Mines. He is now a captain of Engineers in the Officers' Reserve Corps, U.S. Army.

DONALD P. BARNES

His earlier professional work included assignments on design for Morris Dam with the Pasadena Water Department and a short period of highway work with the U.S. Bureau of Public Roads. On his return from Europe, Mr. Barnes spent short intervals with a consulting structural engineer's office in Los Angeles and on investigation work in connection with the Colorado River Aqueduct.

Since the middle of 1934, Mr. Barnes has been continuously with the U.S. Bureau of Reclamation. Work in a variety of fields fell to his lot, including hydraulic model construction and studies with various types of open-channel structures as well as earth-dam and soil-mechanics investigations. His last assignment was as representative of the Bureau at the California Institute of Technology in connection with a large laboratory research program on pump design and behavior for the 65,000-hp pumps for the Grand Coulee plant.

In much of this work even from high school and college days Mr. Barnes has been called upon to write or edit articles and reports. Frequently he had written papers or bulletins for the Bureau. He promoted and edited the series of foreign hydraulics translations which were printed in the November 1937 PROCEEDINGS, a work which was connected with activities of the Society's Committee on Hydraulic Research. He served on the committee of the Soil Mechanics and Foundations Division which prepared Manual 18, "Selected Bibliography on Soil Mechanics."

With this unusually varied background, he possesses a studious disposition, a love of engineering literature, and an extensive acquaintance among engineers, particularly in the Rocky Mountain and Pacific states. Such qualifications of experience and personality should find a logical outlet in the many interests represented in a national engineering publication. Mr. and Mrs. Barnes and their three children have taken up permanent residence in Port Washington, on the northern shore of Long Island, adjacent to New York City.

Your Manuscript in a Pigeonhole?

The Period Has Been Reduced About One-Half During Recent Years

THERE IS NOTHING new in the statement that publishers are inundated by an avalanche of material supplied by writers clamoring to be heard. It applies to engineering papers as well as to other technical forms. And it explains to a large extent the complaint of authors that their manuscripts, nominally accepted for publication, seem to be tucked away and forgotten in a quiet pigeonhole.

Contrary to this lurking impression, such manuscripts are not forgotten. As far as the Society is concerned they receive prompt attention. Recent studies regarding PROCEEDINGS papers indicate that the average interval between receipt of an article and its publication has been reduced to something like six months, the lowest point in some time.

To expedite the publication of material vital to the needs of civil engineers, the Committee on Publications has worked desperately for many years to "grease the ways"—that is, to incorporate into Society practice every possible device for moving the writings of contemporary engineers in a constant stream toward the printing press. That success has met this effort is apparent from a comparative study of final results. The paper that reaches the Society today may be said to be at rest a minimum length of time until it reaches the reader.

In appraising this problem one must recognize that technical literature falls easily and naturally into two categories: (*A*) that which is timely, of popular professional appeal, and likely to lose its value if too long delayed; and (*B*) that which is the product of painstaking research, prepared over months if not years of careful thought and investigation, and subject to thoughtful deliberation and critical review by active-minded practitioners in the profession.

This distinction has been recognized by the Society's Committee on Publications in all its history. Prior to 1895 technical papers (criterion *B*) were published in separate monthly TRANSACTIONS, and only Society affairs, minutes of meetings and such material (criterion *A*) were published in PROCEEDINGS. From then on, by a slow transition, the forms approach the PROCEEDINGS-for-discussion and TRANSACTIONS-for-record format.

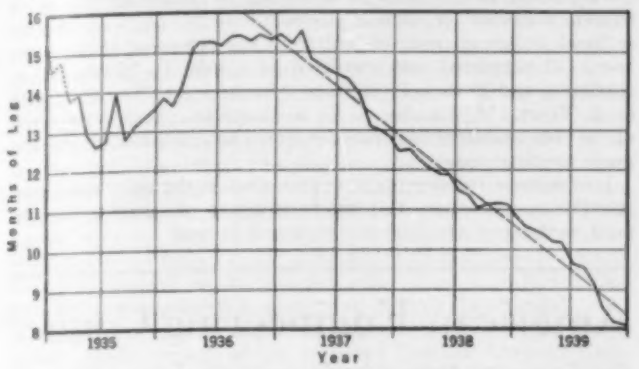
In 1926, when the late Thaddeus Merriman, M. Am. Soc. C.E., was chairman of the Committee on Publications, an effort was made to hasten publication of timely items by introducing a four-page 8 by 11-in. pamphlet as Part 2 of PROCEEDINGS. This pamphlet was compiled and edited personally by the Secretary of the Society and served its purpose admirably through 42 issues, to include September 1930.

Still it was felt that there were many technical papers, not comprehensive or studious enough to merit long discussion, but interesting and valuable from a timely standpoint, which were being largely lost to the membership. Also, many "now" papers (criterion *A*) were being accepted under criterion *B* to bring them to the attention of members in the only form then available.

The next step to improve the situation occurred in 1929, when the late George W. Fuller, M. Am. Soc. C.E., was chairman of the

committee. The August PROCEEDINGS of that year contained a separate department in which all the papers read at the Dallas, Tex., meeting were abstracted. In later months the more important of these papers were printed in full for discussion. These two steps led to the conception of the new publication, CIVIL ENGINEERING, which is celebrating its tenth birthday this month (as noted elsewhere in this issue). This occurred under the chairmanship of the late Harrison P. Eddy, M. Am. Soc. C.E., and CIVIL ENGINEERING owes much to his persistent confidence and wise council.

The obvious effect of CIVIL ENGINEERING was to smooth the way for the speedy publication of "now" papers. A less obvious



REDUCTION OF LAG BETWEEN RECEIPT AND PUBLICATION OF "PROCEEDINGS" PAPERS, 1935–1939

Points on Curve Represent Averages Over Preceding Year

but no less important effect was to expedite and improve the printing of the scholarly papers in PROCEEDINGS.

Evidence of this effect is apparent in data compiled at Headquarters. In appraising this effect it is important to keep clearly in mind the distinction between the "now" class of papers in CIVIL ENGINEERING and the rather more technical, lengthy, and complete papers in PROCEEDINGS. The former are accepted by the Committee often on the basis of its own judgment without waiting for outside review. The PROCEEDINGS paper is not accepted unless it has the almost unanimous approval of a number of expert reviewers, selected carefully from among the Society's roster of 16,000 members, and other experts.

Occasionally, when an author has had only one copy of his manuscript available, it has been necessary to pass it from one reviewer to the next in a long "tour of inspection." This caused a considerable loss of time, which the Committee has largely closed by urging authors to submit at least three copies. Then there is a chance for delay between the time that all reviews are complete and the time of the next quarterly meeting of the Committee on Publications.

This resulting lag, from whatever cause, had improved by the spring of 1935 so that the average successful paper was accepted six months after its date of submission. In the autumn of 1939 the lag had been reduced consistently to a probability of four months, with variations in individual cases. Prompt action by the Committee on Publications is being secured by supplying each member with a typed résumé of reviewer opinions in ample time so that a minimum of discussion will be necessary to reach a conclusion.

After acceptance there is another lag until space can be found for the paper in PROCEEDINGS. This delay was formerly such that, with all the effort previously described, the best that could be promised for a new manuscript received in January 1937 was an average chance of publication in PROCEEDINGS somewhat more than 15 months later. In January 1940 this total probable lag had been decreased to 8 months, as shown on the accompanying graph. Of this reduction of $7^1/_2$ months, one month is accounted for in the interval before acceptance; the remainder, $6^1/_2$ months, in the speeding up (or catching up) of the publication schedule. The latter interval includes provisions for:

1. The editing time
2. Editor's preparation of numerous or complicated drawings
3. Correspondence with the author
4. The author's review of the editing and any revisions
5. The printing schedule

When it is remembered that an arbitrary delay of two months is incurred because PROCEEDINGS is not published in July and August, these data indicate a time interval that will be increasingly difficult to shorten in the future.

Report of Subcommittee on Cores, Cutoffs, and Impermeazation

Presented Before the Soil Mechanics and Foundations Division at the 1940 Annual Convention

The Subcommittee on Cores, Cutoffs, and Impermeazation is one of five subcommittees of the Soil Mechanics and Foundations Division's Committee on Earth Dams and Embankments, whose purpose is "to encourage and correlate research into the phenomena affecting earth dams and their design, with a view to making this information available to the members of the Society through its publications."

THE MEMBERS of the Subcommittee on Cores, Cutoffs, and Impermeazation are of the opinion that its report at this time can be a statement of only general terms. This is due largely to the fact that, to date, sufficient dependable data do not exist on the performance of material, of known characteristics, in and under earth dams already built and in service. Also there is a very wide dissimilarity of even satisfactory materials on which and from which earth dams have been built and there will be no escape from this dissimilarity in the future.

Most of the important earth dams built or started during the last few years have had the base and borrow pit materials fairly well sampled and analyzed by competent soil and laboratory technicians so that the pertinent characteristics of the material under the dam and in all its parts are known and recorded. Also the methods of treatment and placing are matters of record, but generally the records of performance are not yet available. But so far as the cutoff under a dam is concerned, the base material under the usual earth dam is such a heterogeneous deposit of incompletely mixed materials of widely varying characteristics that the usual amount of sampling over the cross section is likely to leave considerable uncertainty as to what the final results will be.

Considerable data could be compiled showing the principal properties of the core material used in several earth dams and to a lesser extent the same sort of data is available for the material under a few earth dams, some with cutoffs and some without cutoffs. In some cases these data would be helpful in judging the material at other sites but it is not believed that they would be sufficiently dependable to justify the time and expense of collecting and publishing them. Each earth dam site has its own peculiar problems which so far as the materials are concerned can be safely and economically dealt with by experienced engineers only after foundations and borrow areas have been thoroughly explored and the materials properly studied and analyzed by competent soil and laboratory technicians.

This Subcommittee feels that the following conclusions are justified at this time:

CORES

1. While there are at least three general types of earth dams, viz.: the homogeneous rolled fill, the composite rolled fill with pervious shells and impervious or less pervious core, and the hydraulic fill of the composite type but in which the material is placed and sorted by hydraulic methods, the function of the core in any type of earth dam is the same and its requirements can usually be met by the proper sorting, mixing, placing, and compacting of the most suitable materials found nearby.

2. An impervious core in an earth dam is always a desirable end to strive for, but unless suitable material is available on or near the site of the work to form a core that will not pass visible or measurable seepage it is often just as satisfactory and cheaper to use a local material that will permit some seepage and provide proper drainage to dispose of the seepage water so as not to saturate too much of the downstream shell of the dam. In providing for the collection and disposal of seepage water emerging from the dam

core or from fine sandy material under the base of the dam, it is important to provide a proper graded filter transition zone from the fine to the coarse so that there will be no piping or movement of the fine saturated material into the voids of the coarser shell material or into the drainage outlets.

3. To date it appears that no satisfactory and economical chemical process has been developed for treating pervious materials to make them impervious before or after compaction into the core of an earth dam.

4. A satisfactory dam of the homogeneous type may be built of highly pervious sand and gravel but it would require some sort of impervious membrane for a water stop such as is used for rock-fill dams.

5. The volume of seepage during a given time that can be passed with safety through a certain length of earth dam will depend somewhat on the sort of material used in the core, and to a greater extent on the permeability and section of the downstream shell and on the adequacy of the drainage system provided, if the shell is not free draining. This can be determined with a fair degree of dependability by laboratory tests and experiments if the material used in the laboratory is so taken from the field and handled in the laboratory as to represent reasonably well the material as finally placed in the dam.

CUTOFFS

1. The only practicable method for making a positive impervious cutoff under a dam is to excavate through any pervious material down to an unbroken impervious stratum and provide a suitable impervious water stop of compacted earth, concrete, or metal from this impervious stratum up to the core of the dam. In many cases, however, a rubber-tight cutoff under an earth dam is not necessary for safety or good economy. With the broad base usually provided for an earth dam for the stability of the dam and for the material under the dam, if the loss of water is of no consequence, a fair volume of seepage can be permitted with safety, provided proper provision is made for its collection and disposal from under the downstream toe of the dam.

2. Where it is uneconomical or otherwise undesirable to excavate to impervious material and construct an impervious cutoff, often interlocking steel sheet piling can be driven for a cutoff. Where boulders, or layers of cemented gravel or of rock do not have to be penetrated, steel sheet piling, of proper weight and design, can be driven with a fair degree of certainty to a depth of around 75 ft. Exceptionally favorable material may permit much deeper driving but splits and curling on both top and bottom multiply rapidly beyond about 75 ft and the cost of discovering and remedying the splits and bottom curls, if properly done, is likely to be considerable. Interlocking steel piling will always permit a small amount of seepage through the interlocks, and the bottom contact with hard rock is rarely ever complete.

3. To date it appears that no satisfactory method of grouting or chemical treatment has been developed to make a pervious fine sand or a mixture of fine sand and gravel impervious over a continuous area so as to constitute a dependable cutoff under a dam. Any injections of grout or chemicals under pressure into such material always seem to find and follow the less resistant small channels or planes, and almost never will such injections form a solid vertical sheet or wall without a converage of holes and vertical application that becomes prohibitive in cost.

O. N. FLOYD, *Chairman*
Spencer J. Buchanan
E. W. Lane
Andrew Weiss

Wind Bracing in Steel Buildings

OF FAR more than passing importance to civil engineers is the final report of Subcommittee 31, Committee on Steel, of the Structural Division. In scope and content it really deserves to be viewed, in effect, as a Manual of Engineering Practice; and the fact that it is to appear in this year's TRANSACTIONS in itself attests to its promise of lasting value. In addition, there will be separate reprints on sale for those who require the report in that form.

Included in the report are complete recommendations on prescribed wind force; provisions for the resistance of wind force; allocation of wind force to braced bents; types of wind bracing; methods of analyzing shallow, deep, and mixed wind bracing systems; secondary stresses; torsional effects; deflection and vibration; permissible stresses; and stability.

Progress reports have been published in PROCEEDINGS in February 1932, December 1933, and March 1936. In CIVIL ENGINEERING, progress reports were published in March 1931 and March 1933. The letters received from interested members far and wide have contributed to the value of the final report in no small degree. The work had its beginning in the original program of the Structural Division's Committee on Steel, of which F. E. Turneaure, Hon. M. Am. Soc. C.E., was chairman in 1930. The work received further impetus as a result of Society findings in the Florida hurricane of 1926. Subcommittee 31, on Wind Bracing in Steel Buildings, was selected from the personnel of the larger group (21 members) and consisted of Clyde T. Morris, N. A. Richards, and Francis P. Witmer, Members Am. Soc. C.E., with C. R. Young, M. Am. Soc. C.E., as chairman. It is to the credit of the subcommittee that this personnel has remained intact right up to the final report.

It is no loose, fulsome praise to state that, in the ten or more years since its appointment, this has been among the most active and hard working of the Society's technical groups.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

STANDARD PRACTICES GUIDE DEFENSE CONSTRUCTION

DISCUSSIONS among representatives of the Army, Navy, and National Advisory Defense Commission have resulted in the adoption of the following policies to govern the award of large construction contracts normally involving the services of both general and subcontractors:

1. Underlying the whole defense construction program, and particularly those projects handled on a cost-plus-a-fixed-fee basis, is the intention that the work not only shall be done soundly, expeditiously, and economically, but that it shall be done with due regard to the generally accepted methods and procedures currently followed in the construction industry; provided of course, that such conforming is consistent with the primary objective of the National Defense Program, namely to build up the nation's defenses in the shortest practicable time.

2. For the construction work it is the intention that each project shall be under one general contract; in the usual run of cases there will be one general contractor, although in specific cases two or more contractors will combine to carry out the work.

3. Each completed project represents the product of the work of several generally recognized trades. The work of these trades is handled on two broad bases:

A. Where the contracting organization (either one general contractor or a group of contractors) on a going basis is made up of specialists in each of the various branches and the work is executed in its entirety by the one contracting organization.

B. Where the contracting organization (either one general contractor or a group of contractors) executes one or more phases of the work such for example as the foundation work, structural work, etc., the other phases being executed on a so-called subcontract arrangement, either cost-plus-a-fixed-fee or a lump sum.

4. When a general contractor or group of contractors is selected by the War or Navy Department, the fee is established with a general understanding as to that phase or phases of the work to be executed by the general contractor or group and those which are to be executed by qualified specialty contractors—subcontractors—under the direction of the general contractor. As the project proceeds it is recognized that some modifications may be found desirable.

5. In establishing the fee under the general contract, it is understood that where qualified specialty organizations are available for the character of the work projected, nothing is contemplated which would be an incentive to the general contractor or group of general contractors to engage in specialty work heretofore not generally executed by his or their own organizations.

6. The method of selecting subcontractors and the basis of

their compensation are to be determined for each case jointly by the Government and the general contractor.

7. It is recognized that the outline above described is not to be held to apply to isolated stations such for example, projects outside the continental limits of the United States where the problems of transportation, housing, recreation, subsistence, and maintenance of order, etc., are such as to practically dictate the form under which all of the work can most advantageously be handled.

Highway-Aid Bill Stresses Defense Requirements

Every two years Congress passes a routine bill continuing the federal-aid system of financing the construction of highways by the various states. This year's measure, which covers the fiscal years ending June 30, 1942 and 1943, for the first time contains a provision that recommendations of the federal agencies concerned with national defense as to highway needs may be given consideration in the selection of roads to be improved with federal funds. This is considered by state officials a radical change in the freedom that has heretofore existed in planning the development by each state of its major highway program, subject only to general regulations regarding the utilization of federal contributions. When coupled with the fact that the annual authorization for each of the two years of $163,500,000 is considerably less than the $200,000,000 authorized in the two preceding years it is feared that state highway development plans may be severely retarded.

Meanwhile the news has come out that the Federal Works Agency, at the request of the National Defense Advisory Committee, is completing a comprehensive inventory of existing highways and bridges to disclose deficiencies from a military viewpoint. While the results are not yet complete, it has been disclosed that 80,000 miles of highway and 2,000 bridges need strengthening, rebuilding, or relocation to avoid potential traffic bottlenecks in time of war, when large-scale movements by mechanized troops, together with possible civilian refugee traffic, would impose a severe load upon the road system. Washington speculation is now revolving around the possibility of a request to Congress for large appropriations to repair the more serious of these weaknesses. The WPA has already announced that henceforth, in selecting its projects, rigid priority will be given to road work and airport construction needed for defense purposes.

Funds Sought to Study Defense Inventions

The newly-organized committee to examine inventions useful in national defense, of which Charles F. Kettering, vice-president in charge of research for the General Motors Corporation, is head, is seeking a fund of $150,000 with which to build up a staff of some 50 trained engineers, patent investigators, and other experts to carry out its objectives. These will include not only the investigation of inventions submitted to it by outside inventors, but also the assignment of unsolved defense problems to inventors and research organizations for study. It is anticipated that the money will be provided by Congressional appropriation, failing which it may be allocated from the President's special emergency fund.

Report Urges Development of Industry in West

Establishment of essential war industries in the Pacific Coast area to provide a better balance to national defense is urged in a report recently submitted to the National Defense Advisory Commission by the Department of the Interior. Low-cost hydroelectric power from federal projects, in addition to mineral and other resources, make possible the setting up in this area of facilities that would eliminate the present necessity of shipping raw and processed materials thousands of miles to supply the needs of the Far West, as well as Hawaii and the Philippine Islands, it is argued. Specifically mentioned as possible of immediate development are the following defense products: aluminum, magnesium, and alloy steels for aircraft engines, ordnance, and ship-building; brass for shell casings and fuses; synthetic nitrogen for explosives; plastics for airplane parts.

Power from the Grand Coulee development on the Columbia River, to be completed in 1941, will be combined with that from the Bonneville project, now in operation, for marketing throughout the Pacific Northwest, according to a decision by the Department of the Interior. The two plants will be linked together by transmission lines that will also distribute the power widely throughout the region. Contracts have already been executed for the use of large blocks of this low-cost power with the Aluminum Company of America and the Sierra Iron Company.

Defense Program Advances

With leases negotiated for the establishment by the United States of a string of air and naval bases in British territories from Newfoundland to Guiana, a joint commission actively planning the coordination of U.S.-Canada defense plans, the appropriation by Congress of an additional $5,000,000,000 defense appropriation, the calling out by the President of the first National Guard units for intensive training, and a bill for general conscription on the point of passage, the past month in Washington has witnessed notable advances in the program to tighten up national defense.

How much construction work will be necessary to prepare the new Atlantic bases for actual use has not yet been determined, but there is little doubt that the volume will be considerable and the urge for speed in development intense. Within a few hours of the consummation of the agreement by which they were made available to this country in exchange for 50 over-age destroyers, American officers were en route to inspect them and recommend a program of improvement. The planning and construction of this work will afford a challenge to the efficiency of the engineering profession.

The latest appropriation bill provides funds for the immediate ordering of 19,000 airplanes, equipment for an army of 2,000,000 men, and 200 warships, all previously authorized in earlier legislation.

New Plant Construction

Total expenditures for plant expansion and new equipment resulting from the defense program are estimated to total from two and one-half to three billion dollars during 1941, according to the Department of Commerce. Normal peace-time expenditures in these categories have been not less than two billion dollars during eight years in the last twenty, according to preliminary estimates from the same source, but dropped to one-third of this amount in 1932 and 1933.

The Defense Commission has worked out a form of contract that will enable business men receiving defense contracts involving new plant construction to use them as a basis for financing such facilities, but before this can be put into effect Congress must amend present laws prohibiting a federal contractor to assign his rights to another. The Commission points out that new plant construction can be roughly grouped into three categories:

1. Those of which the output would be useless in normal times, such as gunpowder plants; these will be built and owned by the federal government, but operated by private industry under management contracts.
2. Factories making products for which there would be an uncertain demand in peace times; these would be financed under the new form of contract under which the government would contract to pay, in five annual installments, for the cost of facilities, with provision for the determination by arbitration, at the end of the five-year period, of the equity in the plant to be held by the government. With this determined the manufacturer could either purchase this equity at the determined value, or alternatively leave title with the government, which would maintain its share in the property as stand-by equipment, or sell it elsewhere.
3. Factory expansions needed to make extraordinary quantities of normal goods. Capital so invested would be protected by permitting the cost of new facilities to be amortized in five years from profits.

Aircraft Production Rises

Although these same uncertainties affect the production of airplanes, and this industry is in addition subject to profit limitations on government contracts, pressure for production from at home and abroad is so intense that a number of manufacturers have embarked upon major plant expansion programs in the expectation that Congress will make equitable adjustment of present laws.

The Reconstruction Finance Corporation has granted loans covering new and expanded plants and equipment for airplane and engine construction to the following: Curtiss-Wright Company, $51,000,000; Bendix Aviation Corporation, $18,587,855; Boeing Aircraft Company, $10,500,000. Curtiss-Wright will build a new airplane engine plant to employ 12,000 workers at Lockland, Cincinnati, Ohio, another new plant at St. Louis, and will expand its existing Buffalo plant. The Bendix loan will be used to expand several of its present factories. Boeing intends both to expand its Seattle plant and to construct a new unit at Wichita, Kans.

An order for 17,000 airplane engines to cost about $180,000,000, to be delivered to both the Army and the Navy during the fiscal years 1941 and 1942, has been awarded to the Pratt and Whitney division of United Aircraft Corporation. Its fulfillment will require the immediate expansion of the company's plant at Hartford, Conn., to the extent of some $2,500,000 for buildings, which will be supplied by the company, and $7,000,000 for equipment, to be bought and owned by the government.

LABOR

Vocational training to meet the demand for skilled labor is "one of the swiftest-moving phases of the defense program," according to Paul V. McNutt, Federal Security Administrator, who reported that 20,000 workers had graduated from training courses by the end of August. The program was started in July and during its first month 80,614 persons enrolled in 283 cities giving courses in such subjects as blueprint-reading, lathe work, milling, welding, pattern-making, sheet-metal work, foundry and machine-shop practice. A plan for the use of the Civilian Conservation Corps as a means of training young mechanics and artisans for defense industries is in preparation.

HOUSING

Shelter for the thousands of new workers to be engaged in defense industries is providing a troublesome problem. The Defense Commission has estimated an immediate need for 110,000 dwellings, with an additional 50,000 necessary when new plants now under construction go into operation. The Navy has been allotted $10,000,000 by President Roosevelt, which will be added to $40,000,000 loaned by the Reconstruction Finance Corporation for construction of housing facilities in areas where the need is acute.

RAILROAD REORGANIZATIONS IMPROVE FINANCES

The financial standing of 25 railroads will be greatly improved under the terms of reorganization plans recently approved by the Interstate Commerce Commission, or now under consideration. In a summary recently made public the Commission disclosed that, for these 25 roads, total capitalization will be reduced from $4,502,550,000 to $2,368,675,000, with annual fixed charges correspondingly cut from $131,462,982 to $39,452,069. Of these plans, the ICC has already approved all but five which still await final action.

The Commission has denied a plea by the trucking industry for the suspension of thousands of rate reductions applying to less-than carload shipments, which accordingly went into effect September 1. These relate to shipments to, from, and within the Southern territory, and were attacked by the truckmen as a "thinly-disguised attempt to destroy the motor-carrier industry." While the plea to suspend operation of these rates was denied, the ICC ordered an investigation into their lawfulness.

Washington, D.C.
September 6, 1940

Backsights

THE FOLLOWING EXCERPTS from the address of Charles Hermany, Past-President, Am. Soc. C.E., on October 3, 1904, at the Louisiana Purchase Exposition, St. Louis, Mo. (TRANSACTIONS, Vol. LIII, December 1904, page 452), although uttered 36 years ago, are of interest in the thinking of today:

"Robert Rawlinson's definition, given more than fifty years ago, was as follows: 'To study precedent, to learn from experience and to correct from practice, are the chief duties of an Engineer.'

* * * *

"In former ages the people had their energies and wealth forcibly appropriated by governments and dissipated in imperial enterprises for apparently no other purpose than the glory and benefit of the few, with degradation and injury to the many. Empires rose and fell like the flow of vapor, fire and lava from a volcano, with apparently no more regard for the welfare of the people than has the force of gravity for the placidity of the mobile ocean upon which, in sport, it plays an endless see-saw. In modern times this is no longer so generally and deplorably true, for now the energies and wealth of peoples are more largely directed, through agriculture, commerce and manufactures, for the benefit of all. The wisdom of conservation has been substituted for the folly of destruction. An era has dawned in which peace, instead of war, tends to pervade more largely the civilization of man, in which dawn the Civil Engineer has been differentiated from the Military Engineer, in which differentiation the adjective, Civil, has been applied with remarkable fitness. In this era, States of great intelligence, wisdom, wealth and power are built up, aggregated into nationalities, whose governments, though in rivalry with those of others, strive, as governments never strove before, to grow great and powerful, not to subjugate and destroy others, but to elevate the citizen and cause him to participate more largely in this greatness and power than in former eras. Out of all this has been evolved the Civil Engineer, who finds here his habitat, his work and his glory.

* * * *

"There is a sentiment prevalent among Engineers that Art must not be permitted to form a prominent feature in engineering works; that it tends to no useful end, involves needless cost, and that it rather impairs use, the sole object in engineering enterprises. This is but a half truth, which, in Engineering, as in all the affairs of man, ranks equal in mischievousness with error or untruth.

"Is it, then possible to eliminate Art from engineering works? The answer is 'No.' The work of the Engineer the world over bears irrefutable testimony against it. Those members of the profession who decry it fail to that extent in rising to the proper dignity which Engineering implies. The extraneous loading of engineering works with ornamentation and decoration, is of course, needless and vicious, for such additions are but questionable appendages to any form of art, but in the true art sense, engineering works rival all forms of art."

Early Events Recalled at Denver Meeting

IN AN ADDRESS at the Wednesday noon luncheon during the July Convention of the Society at Denver, Past-President H. S. Crocker recited a number of experiences both amusing and enlightening from the early activities of the Society.

The first of the four Society Conventions that have been held in Denver was in 1886, according to Colonel Crocker, and was attended by 101 out-of-state members and only two resident members. "The first session was called to order . . . at 15:15 o'clock." At the general session opened to the public in the historic Tabor Grand Opera House, addresses of welcome by the governor and the mayor were responded to by the President and the Vice-President of the Society, respectively.

As part of the excursion program of that Convention, the members were invited by William N. Byers to observe "the operation of our electric railway, believing it will greatly interest you from both engineering and scientific points of view." On one of the mornings, the members "were driven about Denver and its suburbs in the private carriages of their hosts."

The early Local Sections, of which the Colorado Section was the second, were of a highly experimental nature. "An attendance of more than a dozen at a meeting was a rare occurrence, but we did the best we could by means of telephone calls, threats, and cajoleries."

Sounding a note of warning against a too complacent acceptance of the views of others, Colonel Crocker added: "Based upon my connection with the Society extending over nearly forty years, I sometimes wonder what will be its future. I am not a believer in too much harmony. An occasional fight . . . is . . . a healthful indication."

News of Local Sections

Scheduled Meetings

DAYTON SECTION—Luncheon meeting at the Engineers Club on October 21, at 12:15 p.m.

GEORGIA SECTION—Barbecue dinner at the Lakemore Club on October 17, at 6:30 p.m.

ILLINOIS SECTION—Dinner meetings of the Junior Section at the Central Y.M.C.A. on October 14 and 28, at 6 p.m.

ITHACA SECTION—Annual meeting at Willard Straight Hall, Ithaca, on October 17, at 6:30 p.m.

KANSAS STATE SECTION—Dinner meeting at the Kansan Hotel on October 18, at 6:30 p.m.

LEHIGH VALLEY SECTION—Dinner meeting at Drown Hall, Lehigh University, on October 28, at 6:30 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on October 9, at 6:30 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on October 16, at 8 p.m.

MID-SOUTH SECTION—Fall meeting at the Hotel Peabody in Memphis, Tenn., October 25 and 26.

NASHVILLE SECTION—Dinner meeting at the Vanderbilt University Cafeteria on October 1, at 6:30 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers Club on October 8, at 6 p.m.

PROVIDENCE SECTION—Lecture meeting of the Junior Group in the Engineering Societies Building on October 24, at 8 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on October 21, at 12:15 p.m.

SAN FRANCISCO SECTION—Regular bi-monthly meeting at the Engineers Club on October 15, at 5:30 p.m.

SEATTLE SECTION—Dinner meeting at the Engineers Club on October 28, at 6 p.m.

SPOKANE SECTION—Luncheon meeting at the Davenport Hotel on October 11, at 12 noon.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on October 8, at 5:45 p.m.

TEXAS SECTION—Fall meeting at Dallas, October 17–19.

Recent Activities

GEORGIA SECTION—*Atlanta, July 22:* At a special luncheon meeting held to discuss business problems, L. F. Bellinger was asked to head a committee to study the best method of conducting a census of available engineering employees. It was also decided to appoint a committee to consider revision of the by-laws of the Section, and J. A. Higgs, Jr., was appointed chairman.

HAWAII SECTION—*Honolulu, July 9:* The guest speaker was P. E. Bermel, major, Corps of Engineers, U.S. Army, who discussed the engineering problems encountered by the Corps of Engineers in its construction work at Midway Island in the Pacific. Major Bermel illustrated his talk with colored motion pictures.

NEW MEXICO SECTION—*Santa Fe, August 28:* A report on the Annual Convention was given by President W. H. W. Yeo, who represented the Section. The technical program consisted of a talk on the derivation and application of the column analogy method of structural analysis, which was given by Newlin D. Morgan, professor of architectural engineering at the University of Illinois.

OKLAHOMA SECTION—*Cherokee, July 20:* An inspection trip to the Great Salt Plains Dam was made under the direction of the Corps of Engineers, U.S. Army. The group then gathered at Cherokee, where C. H. Guernsey, first vice-president of the Section, was their host at a garden party and outdoor supper. Later there was a program of music and motion pictures of several western dams, including views of the construction of the Great Salt Plains Dam.

PANAMA SECTION: The Section reports that eight meetings and inspection trips have been held since the beginning of the year. One trip, designed especially to appeal to the new members of the Section, was an excursion by motor launch to Madden Dam. On another occasion the headwaters of the rivers tributary to Madden Reservoir were explored by boat. The list of speakers addressing the technical sessions included Allston Dana, formerly engineer of design for the Port of New York Authority, who gave an illustrated lecture on the Bronx-Whitestone Bridge; Lt. Col. T. B. Larkin, in charge of the construction of Fort Peck Dam, who discussed that project; and F. W. Edwards and E. W. Vaughan, respectively hydraulic engineer and chief soil technician for the Panama Canal. The former gave an illustrated lecture on flood control in Los Angeles County, and Mr Vaughan discussed "The Present Status of Soil Mechanics."

SACRAMENTO SECTION—*July 2, 9, 16, 23, and 30, and August 6, 13, and 20:* The usual weekly luncheon gatherings were held during the summer months. Those addressing the July meetings were T. B. Waddell, supervising hydraulic engineer for the State Division of Water Resources; A. B. Willett, structural engineer for the State of California; John Jeffries, technical representative of the Atlas Powder Company, of Wilmington, Del.; H. E. Pomeroy, director of the Sacramento Housing Authority; William Popper, junior bridge engineer for the State Division of Highways; and Max Bookman, assistant hydraulic engineer for the State Division of Water Resources. The speakers at the August luncheons were Alexander D. Russell, a Junior in the Section; Harold Jeffry, bacteriologist for the city; and Charles R. Gallagher, recipient of one of the Alfred P. Sloane fellowships at Yale. *Junior Forum, July 10 and August 13:* At the first of these sessions an illustrated lecture on "The Water System of Sacramento" was presented by Messrs. Russell and Jeffry. At the August meeting Hilton Lusk, aeronautics instructor at Sacramento Junior College, discussed the subject of training aeronautical technicians.

UTAH SECTION—*Junior Forum, Salt Lake City, July 19:* "Sanitary Engineering in Utah" was the subject of discussion, with Howard M. Hurst the principal speaker. Mr. Hurst, who is assistant sanitary engineer for the Utah State Board of Health, spoke on sanitary conditions and water supplies of the state as a whole. Considerable general discussion followed his talk.

SAN FRANCISCO SECTION—*August 9 and 20:* On the first of these occasions members of the Section visited and inspected the U.S. Naval Air Base under construction at Alameda, Calif. The technical program on the 20th consisted of a talk on "Recent Developments in Aircraft Design and Production," given by W. W. Beman, assistant chief research engineer of the Lockheed Aircraft Corporation, at Burbank, Calif. Mr. Beman concluded his talk with a summary of the production of aircraft as a part of the National Defense Program. *Junior Forum, July 18 and August 10:* A symposium entitled "My Job" was presented by R. M. Bickerstaff, Leo W. Ruth, Jr., and L. S. Peletz at the July meeting. The topic for open discussion was whether or not the Society should take a definite stand on social legislation bearing on engineering or be solely an organization for the promotion and distribution of engineering knowledge. In August the group enjoyed an inspection trip to the shipbuilding yards of the Moore Dry Dock Company in Oakland. Two members of the Forum—William C. Hamilton and Gifford M. Randall, engineers with the Moore Dry Dock Company—were in charge of the day's activities and served as guides during the trip through the plant. Dinner and an evening of bowling concluded the excursion.

SECRETARY AND ADVISORY COMMITTEE OF SAN FRANCISCO JUNIOR FORUM

Left to Right: Ferdinand F. Mautz, Dudley F. Stevens (Secretary), William T. Corum, and Frederick L. Weiss

SPOKANE SECTION—*June 14 and July 12:* Winners of the Section prizes of Junior membership in the Society were announced at the June meeting. These are John Erdle, of the University of of Idaho, and Vernon Godsey, of Washington State College. A brief discussion on student competitions concluded the session. The July meeting was devoted to business discussion.

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for November

THAT GREATER ingenuity and common sense in utilizing "immediately available" materials should make for improvements in the design and construction of earth dams is the thesis of B. K. Hough, Jr., writing in the November issue of CIVIL ENGINEERING. Mr. Hough offers some thought-provoking suggestions on materials, seepage, choice of section, and field control of compaction, and his paper should attract not only soil specialists but engineers and construction men whose interests are of a more general nature.

Economics of highway route planning has the major emphasis in D. W. Ormsbee's paper on the "New Monarch Pass Highway in Colorado," also scheduled for November. Length, curvature, elevations, grades, construction cost, vehicle operating costs, and cost of snow removal were all evaluated and studied for three different alinements before the location was finally selected. Construction problems are also discussed briefly.

The idea of employing small storage basins as a supplement to storm-sewer capacity in urban areas is proposed by John A. Rousculp in another article. The author envisages a number of possible economies due to reduction in the required size of new sewers, and suggests that the shallow basins, if properly located and designed, could be used as play areas or for other civic purposes.

"Proposed Standards for Land Descriptions" are discussed by Philip Kissam, who presents "six rules that can be applied immediately with very little change in our present form of descriptions," and a further suggestion as to the "ideal form" for a description to take. Other interesting topics scheduled for November range from reflections on the eighteenth century development of the "concept of engineering" to a discussion of the silt problems of the Colorado River.

A.I.S.C. Committee Studies Steel Specifications

THE Board of Directors of the American Iron and Steel Institute announces appointment of a Special Committee on Government Specifications to cooperate with governmental departments and agencies in formulating and interpreting specifications for steel products. Chairman of the committee is E. C. Smith, chief metallurgist, Republic Steel Corporation, Cleveland, Ohio.

The committee was appointed for the purpose of furnishing information which will enable government officials to bring their specifications more closely into line with commercial specifications in order to expedite production of steel for the national defense program. Many of the existing government specifications have not been brought up to date to include the best practice of the industry.

Inquiries relative to the technical aspects of government specifications for steel may be addressed to the chairman of the committee or to the American Iron and Steel Institute, 350 Fifth Avenue, New York, N.Y.

Industry–University Cooperation

MANY EMPLOYERS in American industry have long gratified the desire of employees to improve their position by providing evening courses for them. Another important step forward has been taken by the University of Pittsburgh, in collaboration with the Aluminum Research Laboratories, in giving graduate college credit for such work so that it can form part of a program leading to an academic degree and an improved professional status.

For the past nine years a number of groups have met at the Aluminum Research Laboratories for the purpose of self-improvement by night study. These persons were either research technicians or plant engineers, some of whom were attending the University of Pittsburgh or the Carnegie Institute of Technology in order to obtain master's or doctor's degrees. It occurred to those receiving instruction that some of the studies at the laboratories were sufficiently advanced to rank with other college postgraduate courses. Consequently Dr. E. A. Holbrook, dean of the School of Engineering and Mines of the University of Pittsburgh, was approached regarding the possibilities of giving credit for these studies to those who were working for higher degrees.

New Kensington, Pa., where the laboratories are situated, is only twenty miles from Pittsburgh, and therefore the problem of residence was one not too difficult of solution. After a thorough consideration of the matter by Dean Holbrook, the management of the laboratories, and Rolland G. Sturm, Assoc. M. Am. Soc. C.E., in charge of the "night school," plans were completed to allow credit for some of the courses, and for the past three years this system has been in force.

During these three years a number of the company's technical staff have cooperated with Dr. Sturm by giving lectures or conducting classes in subjects on which they were particularly qualified. Of the dozen or more thus helping, a number were members of the Society, including R. L. Moore, H. N. Hill, M. Holt, and R. L. Templin.

The enrolment during the year 1939–1940 totaled 145, of which only 22 registrants were from the laboratories, the remainder being employed at the New Kensington, Logans Ferry, and Arnold plants, and at the Pittsburgh office of the Aluminum Company of America. In addition to classes in four engineering subjects, the registrants were invited to attend special lectures on aircraft materials and patents.

The prime mover of the "night school" for the past nine years has been Dr. Sturm. The duties of the venture have now become so complicated that an educational committee has been formed to advise with him in the administration of this service. Under this set-up subjects will be announced by September 1, so that prospective students may know the nature of these evening courses before registering for courses elsewhere. The subjects will be selected from those requested by interested company employees.

An interesting development of the educational program was the institution of the "Annual Engineers' Night" for Aluminum Company engineers, at the close of the school year. It was at such a program that Dean E. A. Holbrook, of the Schools of Engineering and Mines, at the University of Pittsburgh, spoke on "The Engineer and Labor," abstracts from which appear on page 613 of this issue.

The manner in which the postgraduate courses originated deserves a word of mention. Back in 1931, a group of research workers desired to review their mathematics. They approached Dr. Sturm, who consented to teach such a course, and his efforts were so well appreciated that he was asked to repeat the following year. Expansion, after such success, was quite in order. It was after six years of constantly increasing interest that Deal Holbrook was consulted regarding the possibility of allowing credit in the Graduate School at the University of Pittsburgh for certain courses at the laboratories. In the last three years Aluminum Company employees have received a total of more than 100 graduate credits for night school classes.

Reserve Officers Ordered to Active Duty

A NUMBER of members of the Society who are in the U.S. Naval Reserve and in the Officers Reserve Corps of the Army have recently been ordered to report for active duty. Of the Naval Reserve there are Joseph A. Wise, lieutenant commander, Civil Engineering Corps, U.S. Naval Reserve, from associate professor of civil engineering at the University of Minnesota, to the electrical engineering department of the U.S. Naval Academy at Annapolis; Maynard M. Anderson, lieutenant, Civil Engineering

Corps, U.S. Naval Reserve, from senior engineering aide in the U.S. Engineer Office at Los Angeles, to the Twelfth Naval District at San Francisco; Gerald Q. Thacker, lieutenant, Civil Engineering Corps, U.S. Naval Reserve, from the Standard Oil Company in San Francisco, to the Fourteenth Naval District at Pearl Harbor, T.H.; Harrison F. Thrapp, lieutenant, Civil Engineering Corps, U.S. Naval Reserve, from design engineer for the Standard Oil Company of Indiana, to the naval station at Guantanamo Bay, Cuba; James J. Zerbe, lieutenant, Civil Engineering Corps, U.S. Naval Reserve, from the Detroit Department of Public Works, to the naval station at Guam; Lorne C. Parks, lieutenant (jg) Civil Engineering Corps, U.S. Naval Reserve, from the U.S. Engineer Office at Denison, Tex., to the new naval air base at Corpus Christi, Tex.; and Herbert M. Shilstone, Jr., lieutenant (jg), Civil Engineering Corps, U.S. Naval Reserve, from vice-president of the Shilstone Testing Laboratory, Inc., at Houston, Tex., to New York City as Resident Officer-in-Charge for the Navy's new air base project to be constructed at Coco Solo, C.Z.

Similarly, Robert H. Wood, a member of the Officers Reserve Corps of the Army, has been granted a leave of absence from the Mississippi State Highway Department in order to serve for a year as instructor in the Coast Artillery R.O.T.C. unit at Mississippi State College.

Grand Central Terminal on Page of Special Interest

THE PAGE of Special Interest this month contains "before-and-after" views of Grand Central Terminal in New York City. The upper view is from an interesting collection made available by William J. Wilgus, Hon. M. Am. Soc. C.E., whose technical paper on "Grand Central Terminal in Perspective" will appear in the October PROCEEDINGS. Of this "depot," Colonel Wilgus states:

"The depot structure was made up of two dissimilar parts—an L-shaped three-story brick building, 40 ft wide on the south and west along the streets, containing three waiting rooms and overhead offices; and a twelve-track train-shed of arch design, on the north and east, measuring some 200 ft in width, 650 ft in length, and 112 ft in height. The crosstown use of 43d and 44th streets by the public was completely blocked at this point, as was Fourth (Park) Avenue north of 42d Street. East of the depot in Park Avenue were tracks for the use of street cars to and from the downtown Astor House, and still farther to the east were tracks and buildings for the care and storage of steam locomotives and cars."

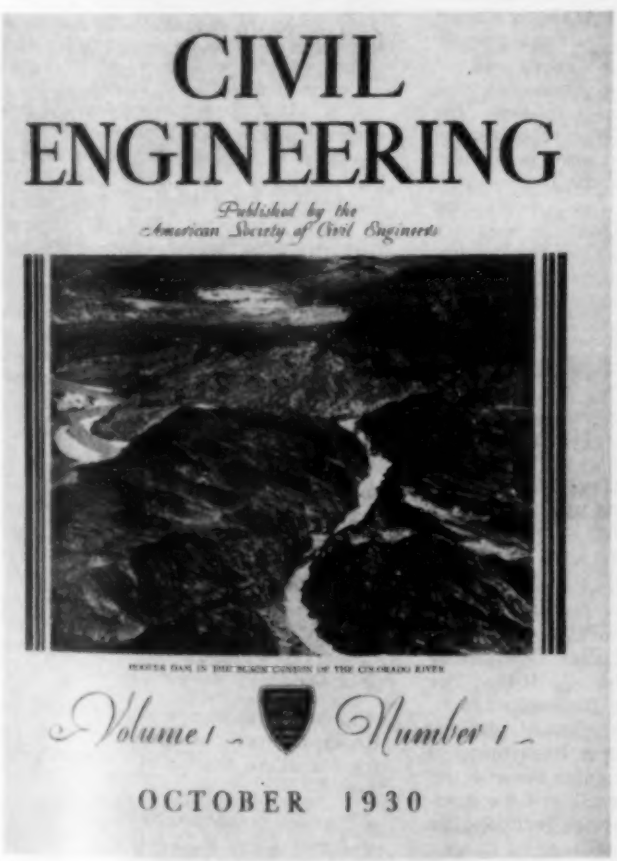
More familiar to engineers will be the present terminal, also shown for comparison. How well it performs its functions is a matter of first-hand knowledge to those who have approached the city from that direction—for the Society's Annual Meeting, perhaps. The present facilities and their far-reaching effects are also treated in this paper, which is a complete technical analysis of the entire development in its engineering, economic, and civic aspects.

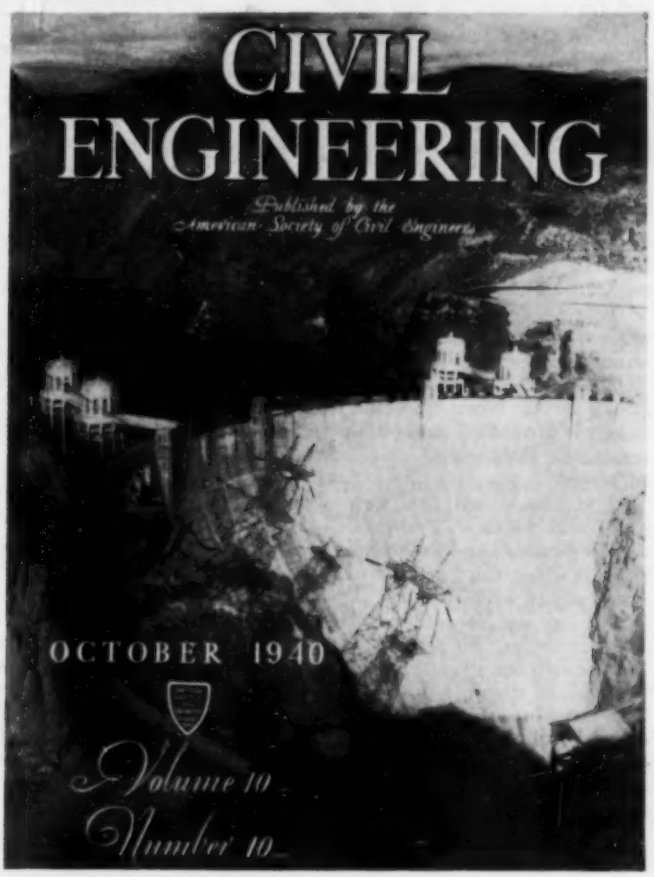
Two Cover Pictures

TEN YEARS ago this month the first issue of CIVIL ENGINEERING came from the press, with an aerial view of Black Canyon on its front cover. On that view, an artist had sketched the outline of Boulder (then Hoover) Dam—the greatest engineering project on the horizon. Inside the issue the leading article, by the late Elwood Mead, M. Am. Soc. C.E., then Commissioner of Reclamation, described the gigantic undertaking, for which contracts were soon to be let.

This month's cover features a somewhat unusual view of Boulder Dam as it is today, the heart and center of a multi-purpose development that is contributing to the comfort and health and economy of a great corner of the nation. And again, as the leading article, there appears a contribution of the present Commissioner of Reclamation, John C. Page, M. Am. Soc. C.E.

As in reclamation, so in all other interests of the civil engineer, this publication has striven during the past decade to record the progress of the profession. Humbly we hope that in some measure we have succeeded.





New Data on Roof Anchorage and on Fire Mains

"ANCHORAGE for Factory Roofs" is the title of a concise and helpful bulletin (7.13) just published by Associated Factory Mutual Fire Insurance Companies, 184 High Street, Boston. Principles of design, design details, and calculations for typical examples are all included. The work is based on extensive study by Factory Mutual and Factory Insurance Association engineers of test data and of effects of the New England hurricane of 1938. Single copies of Bulletin 7.13 can be had free on request to the publishers.

Another recent Factory Mutual publication, also available on request, is "Detailed Specifications for Laying Fire Mains." These specifications are designed to establish a minimum standard practice for private fire protective systems, and should be of value to contractors, water works and manufacturing plant officials, and others having anything to do with installing or letting contracts for such systems.

Prof. N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"GENTLEMEN of the Club, since there is no work on Labor Day, Ken Bridgewater was able to leave his Dunking Bridge, and you can see that he takes no offense when I call him a Hybrid Engineer. Apparently there is no reflection on his ancestry. Eliminating this premise to avoid embarrassment, can anyone suggest the reason for the new title?"

"Is he headstrong, like a mule?" asked Joe Kerr.

"Was he crossed when he was young?" buzzed Amos Keatow.

"Now you're trying to make it too hard," put in the Professor. "A hybrid is a combination of two species of the same genus, often taking its name from a combination of parts of the common names of those species. So a *cattalo* is half cattle and half buffalo; a *plumcot* is half plum and half apricot."

"I have it!" said Cal Klater. "Bridgewater is half bridge engineer and half water engineer!"

"The species are essentially right," answered the Professor, "but the arithmetic is atrocious, since HY BRID is one-third HYdraulic and two-thirds BRIDge."

"And that's just the way my time goes," added Ken. "Two-thirds considering the structure and traffic going over the bridge and one-third making sure that the water will go under it. But my Dunking Bridge up at Nonesuch Narrows is a novel exception, for water must go over and through one span.

"This one span is a draw span that can be lowered into the water so that ships go over it. There is a lot of water traffic, and I figured vehicular traffic would be delayed less by drawing the span a short distance down than a great distance up, as mast heights run about six times the drafts, and the water is deep with only a 10-ft tide range and negligible currents. With an open steel deck, resistance to water passing through is not great. The railing folds on to the deck automatically.

"We made our first draw test last Saturday. At mean tide the span descended 10 ft at full speed until the lower chord contacted the water, then at uniformly decelerated speed for the next 12 ft until the deck was awash, then at half speed for 20 more feet, all in a total time of 60 seconds. That's rather close for comfort, as we guaranteed a 65-second draw at any tide. Our final tests will be made at extreme tides on the 16th; kibitzers are welcome."

"You've built something wilder than my imagination," concluded Professor Neare, "and I'll be there to see if you've been pulling my leg. But your account has included enough information so that we can compute drawing times for extreme tides. Gentlemen, there's a problem, so I'll save the one I had ready."

Brief Notes from Here and There

IN CONNECTION with the National Defense Program, the U. S. Civil Service Commision has announced an open competitive examination to secure junior engineers for Government service. The examinations cover all branches of engineering except aeronautical, naval architecture, and marine engineering. The salary of $2,000 a year is subject to a retirement deduction of 3½%. Applications must be in the Commission's Washington office not later than October 24 if received from states east of Colorado, and October 28, 1940, if received from Colorado and states westward. Applicants must have completed a 4-year engineering course at a recognized college. They will be rated on a written examination consisting of general and professional questions. The maximum age limit is 35 years, unless applicants are granted veteran preference. Full information as to the requirements for the examination, and application forms, may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D.C.

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"PRACTICALLY every aspect of the welding, cutting, and treating processes" will be covered in the five-day meeting of the American Welding Society which opens in Cleveland on October 21. Copies of the complete program can be obtained from the American Welding Society, 33 West 39th Street, New York, N.Y.

* * * *

"NATIONAL defense from a highway and airport angle" will be particularly stressed at the Thirteenth National Asphalt Conference, to be held at Dallas, Tex., during the week of December 9, 1940. The meeting is sponsored by the Asphalt Institute, with the U.S. Public Roads Administration, the State Highway Department of Texas, the Highway Research Board of the National Research Council, and the Association of Asphalt Paving Technologists cooperating.

NEWS OF ENGINEERS

Personal Items About Society Members

HAYWOOD R. FAISON was recently promoted to the position of head engineer in charge of the Section of Special Economic Studies for the Board of Engineers for Rivers and Harbors, U.S. War Department, Washington, D.C.

CHARLES D. CURRAN has resigned as engineer in the office of the Chief of Engineers, U.S. Army, in order to accept the position of budget examiner in the office of the president of the Bureau of the Budget, Washington, D.C.

ALEXANDER M. QUATTLEBAUM is now a member of the engineering faculty at Clemson College, Clemson, S.C.

TROXELL O. MASON has received a commission as second lieutenant in the Coast Artillery Corps of the regular army, with headquarters at Fort Monroe, Va.

KENDALL K. HOYT, who for the past twelve years has been actively engaged in newspaper and publicity work in Washington, D.C., was recently appointed publicity director of the National Aeronautic Association.

ALLEN A. FUTRAL, formerly in the U.S. Engineer Office at Little Rock, Ark., is now with the 70th Coast Artillery at Fort Screven, Ga.

MELVIN P. HATCHER has been appointed chief engineer of the Kansas City (Mo.) Water Department. He was previously associate engineer with the Burns and McDonnell Engineering Company, of Kansas City.

C. C. ARNOLD, who served as assistant engineer on the construction of the Lake Washington pontoon bridge at Seattle, has been named toll bridge engineer for the Washington State Highway Department. In his new work he will be in charge of both the Lake Washington and Tacoma Narrows bridges.

RALPH C. PALANGE, formerly in the U.S. Engineer Office at Providence, R.I., is now with the U.S. Public Health Service. His headquarters are in the Attendants' Building of the U.S. Marine Hospital at Pittsburgh, Pa.

WALDO E. SMITH has accepted an appointment as hydraulic engineer with the U.S. Soil Conservation Service on the flood control work of the Department of Agriculture and entered upon his new duties in Washington, D.C., on August 1. Mr. Smith was formerly connected in a similar capacity with the Muskingum Watershed Conservancy District at New Philadelphia, Ohio.

L. M. BUSH is now chief engineer for Brown-Bellow-Columbia, contractors for the Naval Air Station at Corpus Christi, Tex.

MARCEL GARSAUD, consulting engineer of Jersey City, N.J., was recently made

general manager of the New Orleans Dock Board.

J. GARDNER BENNETT has accepted a position on the engineering staff of Robert College at Istanbul, Turkey.

L. A. LARSON is at present employed as a junior naval architect at the Philadelphia Navy Yard.

O. LEFEBVRE has been appointed vice-president of the Quebec Streams Commission at Montreal, Canada. Mr. Lefebvre was formerly controller of the Provincial Electricity Board of Quebec.

ALFRED W. GAINES, until recently estimating engineer for the George W. Condon Company, of Omaha, Nebr., has been appointed engineer of Harrison County, Iowa, with headquarters at Logan.

CARL A. CARLSON, captain, Civil Engineering Corps, U.S. Navy, was placed on the retired list of navy officers on August 1.

LESLIE W. MAHONE has opened an office at Des Moines, Iowa, to head the state's new merit rating system for employees of the federal-state governmental units. He was formerly assistant professor in the Engineering Extension Service at Iowa State College.

THOMAS E. HUFFMAN has been promoted from the position of district engineer for the Texas State Highway Department at Beaumont, Tex., to that of chief engineer of construction and design. T. J. KELLY, formerly supervising engineer on the Galveston Causeway, succeeds Mr. Huffman as district engineer at Beaumont.

JAMES A. CONWELL has resigned as assistant hydraulic engineer in the Division of Water Resources of the California State Department of Public Works and sailed for the Canal Zone, where he will be with the Engineering Department of the Panama Canal.

LÉON RUCQUOI, former director of the Centre Belgo-Luxembourgeois d'Information de l'Acier, is a recent refugee from Europe, where he served with the Belgian Air Force. Mr. Rucquoi hopes to make this country his permanent home. His present address is The Terraces, Hinsdale, Mass.

JAMES L. EDWARDS and LAWRENCE R. HJORTH have established a consulting practice in New York City under the firm name of Edwards and Hjorth. Both were previously connected with H. G. Balcom and Associates, which is being dissolved. GEORGE A. SALLANS, another member of the firm, has formed a partnership in New York with Sherman A. Callahan, and A. J. WILCOX has opened offices with A. M. ERICKSON, New York consulting engineer.

GEORGE R. BROOKS, lieutenant commander, Civil Engineer Corps, U.S. Navy, has been detached from duty in the 11th Naval District, with headquarters at San Diego, Calif., and transferred to the 15th Naval District, Balboa, C.Z.

ROY P. BISHOP, former director of the Virginia Motor Vehicles Bureau, has been named director of public safety for the city of Durham, N.C.

DECEASED

WILLIAM BOWIE (M. '17) hydrographic and geodetic engineer, U.S. Coast and Geodetic Survey (Retired), Washington, D.C., died in that city on August 28, 1940. Major Bowie, who was 68, entered the service of the U.S. Coast and Geodetic Survey in 1895 and was chief of the Division of Geodesy of the Survey from 1909 until his retirement in 1936. Long active in the affairs of the Society, Major Bowie had been chairman of the Surveying and Mapping Division since its inception and did notable work in connection with efforts to complete the mapping of the United States. He was recently appointed editor of *The Military Engineer*.

WILLIAM BOWIE

CLARKE COPELAND COTTRELL (M. '19) for the past nineteen years an executive of the California State Automobile Association, San Francisco, Calif., died on August 21, 1940. He was 57. Mr. Cottrell's career included service as state highway engineer of Nevada from 1918 to 1921 and, prior to that time, with the U. S. Bureau of Public Roads and the California Division of Highways. A leader in highway development in the West, he was first manager of the Highways Bureau of the Automobile Association and later became manager of its public relations department.

WILLIAM EDWIN EMMETT (M. '31) since 1928 district engineer for the American Institute of Steel Construction at San Francisco, died at Oakland, Calif., on July 16, 1940. He was 54. Mr. Emmett was assistant engineer for the Missouri Valley Bridge and Iron Company from 1909 to 1913; contracting engineer for the Kansas City Structural Steel Company from 1913 to 1924; and contracting engineer for the Moore Dry Dock Company from 1924 to 1928.

GEORGE BRADLEY GASCOIGNE (M. '20) consulting sanitary engineer of Cleveland, Ohio, died on August 17, 1940, at the age of 55. For the past eighteen years Mr. Gascoigne maintained a consulting practice, specializing in the design, construction, and operation of sanitary improvements. Prior to that he was for ten years in the employ of the city of Cleveland, for which he developed a program of sewage treatment.

THOMAS JOSEPH LEAHY (Assoc. M. '13) assistant engineer for the Denver (Colo.) Municipal Water Board, died on August 8, 1940. Mr. Leahy, who was 60, succumbed on the train en route to Denver from Los Angeles, where he had gone for his health. He had been on the Water Board for many years and, at one time, was resident engineer.

MILO SMITH LONG (M. '31) engineer in the U.S. Engineer Office at Nashville, Tenn., died on July 29, 1940, at the age of 51. Mr. Long was in the U.S. Engineer Office at Nashville, Tenn., from 1913 to 1917, and was with Allied Engineers, Inc., of Birmingham, Ala., from 1919 to 1931. He then resumed his connection with the U.S. Engineer Office.

HARRY S. R. MCCURDY (M. '12) for the past thirteen years chief engineer of the Philadelphia Suburban Water Company, died at his home at Bala-Cynwyd, Pa., on August 13, 1940. He was 64. At one time Mr. McCurdy was division engineer for the New York Board of Water Supply engaged on the construction of the Ashokan Reservoir. He had also been with the Morgan Engineering Company, of Dayton, Ohio, and had served as construction engineer on the building of the Philadelphia subways for Patrick McGovern, Inc.

HERMAN CHRISTOPHER NEUFFER (M. '30) consulting engineer of Albuquerque, N.Mex., died there on August 23, 1940, at the age of 49. For the past four years Mr. Neuffer was in partnership with W. R. Holway, engaged in the design and construction of hydraulic and hydroelectric projects in the Southwest. Before that—1919 to 1922 and, again, 1924 to 1936—he was with the U.S. Indian Irrigation Service, acting as designing engineer on Coolidge Dam and numerous other structures.

JOSEPH ARNOLD NORCROSS (M. '05) consulting engineer of New Haven, Conn., died suddenly at Dover-Foxcroft, Me., on August 19, 1940, at the age of 70. From 1894 to 1903 Mr. Norcross was engineer for Humphreys and Glasgow, of London, in charge of the erection of gas works in many European cities. From the latter year until his retirement in 1929 he was associated with the New Haven Gas Light Company, serving successively as chief engineer, secretary-treasurer, and vice-president and general manager.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

WILLIAM HALE PHILLIPS (M. '17) senior engineer of general construction for the State of California, Oakland, Calif., died on June 22, 1940, at the age of 61. From 1908 to 1910 Mr. Phillips was bridge draftsman for the City of Spokane, Wash.

In the latter year he established a consulting practice, which he maintained until 1936, when he became senior engineer of general construction for the State of California.

CARROLL LELAND TINDALL (Assoc. M. '30) for the past two years with the Mene Grande Oil Company at Barcelona, Venezuela, died there on August 5, 1940. He was 47. Mr. Tindall had been resident engineer for the North Carolina State Highway Commission; division engineer for the National Commission of Highways of Mexico; project engineer for Harris County, Texas; and division engineer for the Latin American Construction Company at San Jose, Costa Rica.

ALBERT KENDALL WARREN (Assoc. M. '19) chief engineer and general manager of the Los Angeles County Sanitation District, Los Angeles, Calif., died on August 28, 1940, at the age of 60. From 1914 to 1925 Mr. Warren was senior engineer in the county surveyor's office, and he received his appointment to the head of the department in 1925.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From August 10 to September 9, 1940, Inclusive

ADDITIONS TO MEMBERSHIP

AKERS, JAMES BYRNSIDE (M. '40), Asst. Chf. Engr., Southern Ry. System, Box 1808, Washington, D.C.

BLANKS, ROBERT FRANKLIN (M. '40), Senior Engr. (Civ.), U.S. Bureau of Reclamation, U.S. Custom House, Denver, Colo.

BLIFFERT, WESLEY PHIL (Assoc. M. '40), Engr., Tews Lime & Cement Co., 1136 East North Ave., Milwaukee, Wis.

BRAUNSTEIN, LEONARD (Jun. '40), Junior Civ. Engr., U.S. Engr. Office, War Dept., 1014 Chamber of Commerce Bldg. (Res., 903 Norfolk St.), Pittsburgh, Pa.

BROADHURST, EDWARD MARQUETTE (Jun. '40), Public Health Engr., Walker-Catoosa Health Dept., Court House, La Fayette, Ga.

BROWN, ANDREW JOSEPH (M. '40), Asst. Structural Designer, Dept. of Subways and Superhighways, City of Chicago, 20 North Wacker Drive (Res., 7632 Colfax Ave.), Chicago, Ill.

CAPESIUS, VIRGIL MICHAEL (Jun. '40), Asst. Insp. (Dredging), U.S. Engr. Dept., 1709 Jackson, Omaha (Res., 607 West 5th St., Fremont), Nebr.

CHADWICK, WILLIAM JACOB (Assoc. M. '40), Asst. City Engr., City Hall (Res., 1709 Park Ave.), Racine, Wis.

CHAMPAGNE, RALPH GEORGE (Assoc. M. '40), Chf. Engr., The Callanan Road Impvt. Co., South Bethlehem (Res., 301 Lucas Ave., Kingston), N.Y.

CHARLESON, DONALD MCKAY (Jun. '40), Asst. Eng. Aide, U.S. Army Engrs., 4074 North Court Ave., Portland, Ore.

CLARK, ROBERT WILLIAM (M. '40), Business Mgr., State Highway Dept., State Office Bldg., Hartford (Res., 438 Broad St., Windsor), Conn.

COBERLY, CARROLL H. (Assoc. M. '40), 1441 Welton, Denver, Colo.

COLLIE, ROBERT MONROE (Jun. '40), Care, Frederic R. Harris, Inc., 27 William St., New York, N.Y.

DAVEY, GEOFFREY INNES (Assoc. M. '40), Cons. Engr., Haskins, Davey & A. G. Gutteridge, 60 Hunter St., Sydney, Australia.

DELANEY, AUGUSTINE LEO (Assoc. M. '40), Designer, Dept. of Structures, Erie R.R., 738 Midland Bldg., Cleveland (Res., 124–93 Cedar Rd., Cleveland Heights), Ohio.

ELKIND, BENJAMIN (M. '40), Chf. Draftsman, Erie R.R. Co., Room 739 Midland Bldg. (Res., 2040 East 96th St.), Cleveland, Ohio.

ELLIOTT, DONALD SAGER (Assoc. M. '40), Civ. Engr., T.P.M.P.R.R. of New Orleans, 1384 Annunciation (Res., 1328 Jackson Ave.), New Orleans, La.

ELLIS, BENJAMIN HENRY (Assoc. M. '40), Chf. Mech. Engr., W. H. Gahagan, Inc., 147 Remsen St., Brooklyn (Res., 112–06 Two hundred and second St., St. Albans), N.Y.

EVANS, CHARLES ANDREW (Jun. '40), Junior San. Engr., TVA, Commercial Bank Bldg., Paris, Tenn.

FENNER, LEWIS EDWIN (Assoc. M. '40), County Highway Engr., Manitowoc County Highway Dept., Court House (Res., 632 North 5th St.), Manitowoc, Wis.

FLANAGAN, JEFF E. (Assoc. M. '40), Asst. Hydr. Engr., Bureau of Agri. Economics, U.S. Dept. of Agriculture, Box 1105, Albuquerque, N.Mex.

FLANAGAN, WILLIAM EDWARD (Affiliate '40), Parkside Hotel, Washington, D.C.

FLANDERS, DONALD LEE (Jun. '40), With Magnolia Petroleum Co., Box 600, Dallas, Tex. (Res., 5515 Crestwood Drive, Kansas City, Mo.)

GRENNAN, PHILIP MICHAEL (Assoc. M. '40), Care, Republic Fireproofing Co., 31 Union Sq., New York, N.Y.

GRIME, EDWIN MORRELL (M. '40), Engr., Water Service, N.P. Ry., Room 1200 N. P. Bldg., St. Paul, Minn.

GROSS, SEYMOUR (Jun. '40), Estimator and Engr., Donley Bros., Inc., 39 George St., Boston (Res., 90 Grovers Ave., Winthrop), Mass.

HALVORSON, SIGURD (Jun. '40), Senior Draftsman, U.S. Engrs., 628 Pittock Block, Portland, Ore.

HARRINGTON, PHILIP (M. '40), Commr. of Subways and Superhighways, City of Chicago, 20 North Wacker Drive, Chicago, Ill.

HOLCOMBE, WILLIAM HENRY (M. '40), Lt. Col., Corps of Engrs., U.S. Army, Fort Belvoir, Va.

HOLLWEG, RALPH (Assoc. M. '40), Junior Civ. Engr., State Div. of Highways, 122 West Main St., Babylon (Res., 160–09 Sanford Ave., Flushing), N.Y.

HORAN, FRANK WILLIAM (M. '40), Prof., Civ. Engr., Univ. of Notre Dame, Notre Dame (Res., 914 Diamond Ave., South Bend), Ind.

HURLEY, HENRY WRIGHT (Jun. '40), 1st Lt., C.E., U.S. Army, 17th Engrs., Fort Benning, Ga.

JELINEK, OTTO KOPP (M. '40), Traffic Engr., Chicago Park Dist., Administration Bldg., Burnham Park (Res., 5341 South California Ave.), Chicago, Ill.

KETCHUM, VERNE LEE (M. '40), Cons. Engr., 3144 North East 43d Ave., Portland, Ore.

LEACH, WILLIAM OSLER (Assoc. M.'40), Engr., Box 802, Coleman, Tex.

MCCRACKIN, THOMAS HUNTER, JR. (Jun. '40), Testing Asst., Univ. of Illinois, Talbot Laboratory, Urbana (Res., 624 East Green, Champaign), Ill.

MAUEL, EDWARD (Jun. '40), 4521 North Spaulding Ave., Chicago, Ill.

MILNER, LEROY MONROE, SR. (Assoc. M. '40), Insp., U.S. Engrs., Box 97, Memphis, Tenn.

NEVILLE, JAMES LISLE (Assoc. M. '40), Civ. Engr., Paulette & Wilson, Salina, Kans.

OCVIRE, FRED WILLIAM (Jun. '40), Draftsman and Detailer, International Conveyor & Washer Corp., 640 East Fort St. (Res., 10104 Puritan Ave.), Detroit, Mich.

PATTERSON, DEE ALDEN (Jun. '40), With Burns & McDonnell Eng. Co., 107 West Linwood, Kansas City, Mo. (Res., 2445 East Magnolia, Knoxville, Tenn.)

PEREZ, JESUS PEREZ (Jun. '39), Civ. Engr., National Irrig. Comm., Balderas 94 (Res., Michoacan 81–11), Mexico, D.F., Mexico.

POPE, ROBERT JOHN (Jun. '40), Eng. Aide, War Dept., 628 Pittock Block, Portland (Res., Park Place), Ore.

RADLEY, HARMON MONROE (Assoc. M. '40), Project Engr., Federal Works Agency, Public Buildings Administration, Procurement Bldg. (Res., 1609 Thirty-first St., N.W.), Washington, D.C.

SEIF, EMANUEL (Jun. '40), 189 South 9th St., Brooklyn, N.Y.

SHEPHERD, RICHARD BUTLER HOOKE (Assoc. M. '40), Asst. Civ. Engr., U.S. Engr. Office, Box 97, Memphis, Tenn.

SHERMER, CARL LOUIS (Jun. '40), Engr., Lockheed Aircraft Corp., Burbank (Res., 101 North Hill St., Pasadena), Calif.

SIMPSON, KENNETH (Assoc. M. '40), 10138 Pescadero, South Gate, Calif.

SITZLER, JOHN BOGER (Assoc. M. '40), Prin. Asst. Engr., Dept. of Public Works, City Hall (Res., 211 Springdale Ave.), Peoria, Ill.

SPEARS, RALPH WESTLY (Jun. '40), Insp. (Gen. Constr.), U.S. Engrs., Kansas City Dist., Kanopolis Dam, Ellsworth, Kans.

STUBBLEFIELD, WILLIAM MAXWELL (Jun. '40), Care, Pacific Gas & Elec. Co., 1125 Spruce St., Berkeley, Calif.

STURGES, FRANK CALEB (Assoc. M. '40), Gen. Mgr., Pennsylvania Drilling Co., 1205 Chartiers Ave., Pittsburgh (Res., Baptist Rd., R.D. 1, Library), Pa.

THOMASSON, HORACE GORDON, JR. (Jun. '40), Asst. Hydr. Engr., U.S. Geological Survey, Room 6, Post Office Bldg., Fort Smith, Ark.

WALLACE, JAMES NICHOLAS (Assoc. M. '40), Dist. Maintenance Engr., State Road Comm., 2224 Fifth Ave. (Res., 2761 First Ave.), Huntington, W.Va.

WENGER, FRANK EDWARD (Assoc. M. '40), Office Engr., Russell & Axon, 4903 Delmar Blvd., St. Louis, Mo.

WIEDEMAN, ALBERT FRED (Jun. '40), Asst. Traffic Engr., State Div. of Highways, 416 Centennial Bldg., Springfield, Ill.

WOOD, GARDNER KENNETH (Assoc. M. '40), Associate Engr., U.S. Geological Survey, 945 Post Office Bldg., Boston (Res., 151 Mason Terrace, Brookline), Mass.

WOOD, ROBERT LEO (Assoc. M. '40), Project Engr., State Highway Comm., Box 525, Vincennes, Ind.

WOOLHISER, ROY ELLIS (Jun. '40), Asst. Civ. Engr., Fish and Wildlife Service, Germfask, Mich.

YOUNG, FRANCIS DEWEY (Assoc. M. '40), Asst. Sales Mgr. (Pipe Div.), Johns-Manville Sales Corp., 1530 Builders Exchange Bldg. (Res., 14603 Milverton Rd.), Cleveland, Ohio.

ZALKIND, GEORGE OSSIP (Assoc. M. '40), 1235 Grand Concourse, New York, N.Y.

TOTAL MEMBERSHIP AS OF SEPTEMBER 9, 1940	
Members	5,678
Associate Members	6,550
Corporate Members	12,228
Honorary Members	31
Juniors	4,233
Affiliates	72
Fellows	1
Total	16,565

MEMBERSHIP TRANSFERS

ALEXANDER, JOHN BILLINGS (Assoc. M. '31; M. '40), Prin. Engr., U.S. Engr. Office, Citizen's National Bank Bldg. (Res., 1111 West Sears St.), Denison, Tex.

ARNETT, ROBERT WILLIAM (Jun. '29; Assoc. M. '30; M. '40), Asst. Prof., Civ. Eng., Columbia Univ., New York, N.Y.

CANALS, CESAR SOCORRO (Jun. '27; Assoc. M. '35; M. '40), Res. Engr., Frederick Snare Corp., 114 Liberty St., New York, N.Y.

CLARK, KENNETH ALLEN (Jun. '28; Assoc. M. '40), Engr., S. A. Healy Co., 14 Fisher Lane (Res., 135 Concord Ave.), White Plains, N.Y.

FILLION, STANLEY HERBERT (Jun. '30; Assoc. M. '40), Asst. Prof., Civ. Engr., Worcester Polytechnic Inst. (Res., 14 May St.), Worcester, Mass.

HAAS, EDWARD THOMPSON (Jun. '33; Assoc. M. '40), Vice-Pres. and Gen. Mgr., Williams Brothers & Haas, Inc., 1104 Merchants Exchange Bldg., San Francisco, Calif.

HATCH, GRAHAM McFIE, JR. (Jun. '38; Assoc. M. '40), San. Engr., Public Health Dept., 202 City Hall Annex, Dallas, Tex.

MCNEAL, DONALD HAMLIN (Assoc. M. '29; M. '40), Deputy Gen. Mgr., HOLC, Home Owners Loan Corp. Bldg., Washington, D.C.

NUTTER, BEN EARL (Jun. '36; Assoc. M. '40), Engr., Concrete Products Div., Graham Brothers, Inc., 3425 Fowler St. (Res., 736 Parkman Ave.), Los Angeles, Calif.

OLANDER, RALPH CARL (Jun. '33; Assoc. M. '40), Asst. Civ. Engr., Fish & Wildlife Service, Kenmore, N.Dak.

REICKERT, FREDERICK ARTHUR (Jun. '38; Assoc. M. '40), Designer, Hazelet & Erdal, 53 West Jackson Blvd. (Res., 1430 North Dearborn Parkway), Chicago, Ill.

RIDDICK, THOMAS MOORE (Jun. '32; Assoc. M. '40), Cons. Engr. and Chemist, 369 East 149th St., New York, N.Y.

SCHMITT, WALTER FREDERICK (Jun. '30; Assoc. M. '40), Insp., Middle Dept. Rating Assn., Sub. Div., 401 Walnut St., Philadelphia (Res., 100 Harding Ave., Hatboro), Pa.

SNOW, EDWIN JAMES (Jun. '31; Assoc. M. '40), Junior Engr., U.S. Engr. Office, Clock Tower Bldg., Rock Island, Ill.

SOLER-LOPEZ, ERNESTO ANTONIO (Jun. '34; Assoc. M. '40), Asst. Engr., U.S. Engr. Office, Arsenal, San Juan, Puerto Rico.

WAGNER, RICHARD CARL (Jun. '29; Assoc. M. '40), Engr., State Highway Comm., State House Annex, Indianapolis (Res., 132 West Fordice St., Lebanon), Ind.

WALLACE, KEITH KERNEY (Jun. '35; Assoc. M. '40), Asst. Civ. Engr., Board of Water Supply (Res., 3122 Huelani Drive), Honolulu, Hawaii.

WHITEHEAD, RICHARD STANLEY (Jun. '31; Assoc. M. '40), Engr., State Planning Board, 441 Public Works Bldg. (Res., 370 Thirty-Sixth St.), Sacramento, Calif.

WOOLLEY, LOGAN HOWARD (Jun. '30; Assoc. M. '40), Associate Engr. (Civ.), U.S. Engr. Office, 1709 Jackson, Omaha, Nebr.

REINSTATEMENTS

BLASCHKE, THEODORE OSCAR, Assoc. M., reinstated Sept. 6, 1940.

FYLER, CARLETON MILLS, Assoc. M., reinstated Sept. 3, 1940.

LYONS, WILLIAM THEODORE, Assoc. M., reinstated Sept. 7, 1940.

SASSO, MAURICE, M., reinstated Sept. 3, 1940.

RESIGNATIONS

HILL, GEORGE MITCHELL, Assoc. M., resigned Sept. 5, 1940.

UNDERHILL, ALPHEUS FINCH, Assoc. M., resigned Aug. 19, 1940.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

October 1, 1940 NUMBER 10

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

ALLNER, FREDERICK ABELS (Assoc. M.), Baltimore, Md. (Age 58) (Claims RCA 2.1 RCM 30.8) Nov. 1909 to date with Pennsylvania Water & Power Co., Holtwood, Pa., as Asst. Chf. Engr., Gen. Supt., and (since Dec. 1933) Vice-Pres.; also, Nov. 1929 to date Gen. Supt., Safe Harbor Water Power Corporation, Baltimore, Md.

BAIL, ERNEST BENJAMIN, Albuquerque, N.Mex. (Age 58) (Claims RCM 14.0) June 1923 to May 1931, June 1935 to Feb. 1936, and Dec. 1936 to date with New Mexico State Highway Dept., as Project Engr., Asst. Dist. Engr., Dist. Engr., Constr. Engr., and (since Feb. 1939) Engr., Plans and Surveys.

BAILEY, SAMUEL MAJOR (Assoc. M.), Louisville, Ky. (Age 46) (Claims RC 19.2 D 7.9) Sept. 1930 to date with U.S. Engr. Office as Asst. Engr., Associate Engr., Engr., and (since May 1937) Senior Engr., Prin. Civ. Asst. to Dist. Engr.

BAUER, JOHN VICTOR, St. Albans, N.Y. (Age 37) (Claims RCA 0.1 RCM 5.7) Sept. 1932 to date Instructor in Civ. Eng., Coll. of City of New York.

BITNER, MELVILLE SPERRY (Assoc. M.), Estes Park, Colo. (Age 35) (Claims RCA 5.3 RCM 5.2) Sept. 1933 to Aug. 1934 and Jan. 1936 to date with U.S. Bureau of Reclamation as Jun. Engr., Asst. Engr., and (since Sept. 1939) Associate Engr.

BRINCKMAN, ALBERT LEACH, Berkeley, Calif. (Age 39) (Claims RCA 7.5 RCM 5.6) Sept. 1927 to date with City of Berkeley, Calif., as Plan Checker, Office Engr., Inspector, and (since March 1935) Chf. Bldg. Inspector.

BROWNE, FLOYD GILMORE (Assoc. M.), Marion Ohio. (Age 47) (Claims RC 16.1 D 8.6) Feb. 1932 to date Cons. Engr., later Chf. Engr. and Head of firm, Floyd G. Browne & Associates, Cons. Engrs.

BUCHANAN, SPENCER JENNINGS (Assoc. M.), Vicksburg, Miss. (Age 37) (Claims RCA 2.5 RCM 8.8) June 1933 to Aug. 1939 and Dec. 1939 to date with U.S. Waterways Experiment Station as Soil Engr., Associate Engr., Engr., and (since Dec. 1939) Soils Engr., Chf. of Soils Div., in the interim Cons. Engr., Vicksburg (Miss.) Bridge Co.

CARIGAN, WILLIAM EVERETT, Liberty, Ky. (Age 62) (Claims RCA 13.0 RCM 4.0) 1930 to 1932 and 1937 to date with Kentucky State Highway Dept., as Supervisor of Maintenance, Div. 6, Danville, Ky., and (since 1937) Inspector of Constr., 6th Road Dist.; in the interim Senior Foreman of Constr., U.S. Forest Service, Morehead, Ky.; Project Officer, CWA, Casey County (Ky.).

DAVIS, FRANCIS MARION (Assoc. M.), Paris, Tex. (Age 36) (Claims RCA 2.6 RCM 9.4) Feb. 1929 to date with Texas State Highway Dept., as Asst. Res. Engr., Res. Engr., and (since April 1932) Asst. Dist. Engr.

EMERSON, CHERRY LOGAN, Atlanta, Ga. (Age 52) (Claims RCA 7.0 RCM 16.0) 1919 to date with Robert & Co., Inc., as Power Engr., Chf. Engr., and Vice-Pres.

FANNING, GEORGE STOKES, Cleveland, Ohio. (Age 55) (Claims RCA 9.1 RCM 24.4) March 1913 to date with Erie R.R. Co., as Res. Engr., Estimating Engr., Chf. Draftsman, Asst. to Chf. Engr., Office Engr., Prin. Asst. Engr., Asst. Chf. Engr., and (since June 1929) Chf. Engr.

HICKOX, GEORGE HAROLD (Assoc. M.), Norris, Tenn. (Age 37) (Claims RCA 4.0 RCM 6.1) March 1935 to date Senior Hydr. Engr., TVA, Knoxville, Tenn., in charge of hydraulic laboratory.

HOLTON, PHILIP JOSEPH, JR., Providence, R.I. (Age 43) (Claims RCA 1.4 RCM 16.3) April 1933 to date Supt. of Water Dept., City of Providence, R.I.

MILINOWSKI, ARTHUR SIEGFRIED, St. Paul, Minn. (Age 57) (Claims RCM 32.5) June 1920 to date member of firm, Druar and Milinowski, Cons. Engrs.

PYLE, IRA LAWRENCE, Richmond, Va. (Age 63) (Claims RC 36.5 D 25.5) June 1902 to date with Chesapeake & Ohio Ry. Co., as Levelman, Transitman, Res. Engr., Asst. Engr., Draftsman, Asst. Engr. of Constr., Asst. Chf. Engr., and (since Sept. 1939) Chf. Engr.

SCALES, RICHARD MILLS, Houston, Tex. (Age 37) (Claims RCA 4.4 RCM 6.9) March 1925 to date with Eng. Dept., City of Houston, as Student Jun. Draftsman, Jun. Draftsman, Senior Draftsman, Designing Draftsman, Asst. Engr., and (since Dec. 1938) Asst. City Engr.; also, 1934 to date in private practice.

SCHILLING, KARL BROWNE, Sardis, Miss. (Age 44) (Claims RCA 1.4 RCM 18.1) Nov. 1918 to Jan. 1931 and June 1932 to date with Corps of Engrs., War Dept., U.S. Army, as 2d Lieut., 1st Lieut. and since Nov. 1934 Capt., since July 1940 acting as Dist. Engr., U.S. Engr. Office, Vicksburg.

STIRLING, VINCENT REYNOLDS, Duluth, Minn. (Age 57) (Claims RCA 11.7 RCM 14.9) Oct. 1930 to date Senior Civ. Engr., U.S. Engr. Office, in charge of Eng. Sec.

SULLIVAN, HENRY JOSEPH, Washington, D.C. (Age 47) (Claims RCA 7.6 RCM 9.2) Oct. 1933 to date Examiner, Sec. Chf., Asst. Director of Eng., Associate Director of Power, and Asst. to Director of Eng., PWA.

TEDESKO, ANTON, Chicago, Ill. (Age 37) (Claims RCA 3.0 RCM 8.0) 1932 to date with Roberts & Schaefer Co., Cons. Engrs., as Designing Consultant, Constr. Supt., and (since May 1934) Mgr., Structural Dept.

VINCENT, GEORGE SYLVESTER (Assoc. M.), Ft. Worth, Tex. (Age 44) (Claims RCA 8.5 RCM 10.1) July 1930 to date with U.S. Bureau of Public Roads (PRA) as Highway Bridge Engr.

WAHL, CARL MERRILL, Springfield, Ill. (Age 43) (Claims RCA 2.6 RCM 17.3) 1920 to date with Illinois Div. of Highways as Jun. Highway Engr., Dist. Office Engr., Dist. Constr. Engr., Supt. of Day Labor Constr., and (since 1933) Gen. Inspector, Bureau of Constr.

YONKMAN, NICHOLAS FRED, Cadillac, Mich. (Age 46) (Claims RCA 8.8 RCM 7.1) April 1919 to Jan. 1922 and Jan. 1934 to date with Michigan State Highway Dept., as Instrumentman, Project Engr., and (since Feb. 1935) Asst. Dist. Engr. (in charge of maintenance).

APPLYING FOR ASSOCIATE MEMBER

BAIRD, RALPH WALDO, Waco, Tex. (Age 37) (Claims RCA 8.1 RCM 3.8) Nov. 1935 to date with SCS, Hydrologic Div., as Associate Agri. Engr., and (since Nov. 1936) Hydr. Engr.

BARROWS, WILBUR RAYMOND (Junior), Fountain City, Tenn. (Age 32) (Claims RCA 5.6) Nov. 1936 to date with TVA, Knoxville, Tenn., as Asst. Structural Engr., and (since Aug. 1937) Associate Structural Engr.; previously Hydr. Designer, Harza Eng. Co., Columbus, Nebr.

BOYER, MARION CLIFFORD (Junior), Silver Spring, Md. (Age 32) (Claims RCA 5.3 RCM 3.0) July 1928 to date with U.S. Geological Survey as Jun. Hydr. Engr., Asst. Hydr. Engr., and (since Dec. 1936) Associate Hydr. Engr., being Prin. Asst. to Chf. of Reports Sec.

BROOKS, ROBERT BLEMKER, JR. (Junior), University City, Mo. (Age 27) (Claims RCA 5.3) Oct. 1937 to date with Shell Oil Co., Inc., on cadastral engineering; previously Asst. Engr. with Robert B. Brooks, Cons. Engr., St. Louis, Mo.

BURKS, DARNALL, Arlington, Va. (Age 34) (Claims RCA 7.6 RCM 4.0) March 1931 to date with U.S. Forest Service, as Asst. Engr., Region 7, Associate Engr., Region 8, and (since Aug. 1935) Asst. to Regional Engr., Region 7.

CARLSON, HARRY (Junior), St. Paul, Minn. (Age 32) (Claims RCA 3.6) May 1934 to date with U.S. Engr. Office, St. Paul, Minn., as Inspector of Construction Materials, Senior Eng. Aide, Asst. Engr., and (since Jan. 1940) Associate Engr.

CARTER, GEORGE RICHMOND (Junior), Edwardsville, Ill. (Age 32) (Claims RCA 5.0) July 1935 to date with Soil Conservation Service as Facilitating Technician (Oct. 1939 to July 1940) and remainder of time Camp Engr.

CUDWORTH, ARTHUR GEORGE (Junior), Denver, Colo. (Age 33) (Claims RCA 2.5) March 1937 to date Structural Engr., with Western Portland Cement Assn., Silver-Roberts Iron Wks., Shankland, Ristine & Co., and (since March 1939) Colorado Bldrs. and Supply Co.; previously Bridge Draftsman, Denver & Rio Grande Western R.R. Co.

DENNIS, RICHARD WHITING (Junior), Los Angeles, Calif. (Age 32) (Claims RCA 1.6) March to Sept. 1939 Draftsman, and April 1940 to date Designer, Southern California Edison Co. Ltd.; previously with Stone and Webster Eng. Corporation, as Inspector, Draftsman, and Engr. of Research; with U.S. Engr. Office, Frank L. Howard Eng. Co., and The Metropolitan Water Dist. of So. Calif.

DIDDEN, CLEMENT ALBERT (Junior), Washington, D.C. (Age 32) (Claims RCA 5.1) Sept. 1938 to date Engr. and Asst. Supt., Penker Constr. Co., Cincinnati, Ohio; previously Supt. of Constr., F. H. Martell Co.; Engr. and Asst. Supt., John W. Cowper Co., Buffalo, N.Y.

EATON, RICHARD ORVILLE, Washington, D.C. (Age 33) (Claims RCA 2.1) June 1939 to date with U.S. Beach Erosion Board as Associate Engr. (Civil), and Engr. (Civil); previously with U.S. Engr. Dept., as Surveyman, Inspector, Senior Eng. Aide, Chf. Eng. Aide, and Associate Civil Engr.

FRANK, JOHN ELDEN, Ft. Thomas, Ky. (Age 44) (Claims RCA 12.9) Aug. 1926 to date with U.S. Engr. Office, as Surveyman, Asst. Civ. Engr., and (since June 1939) Associate Civ. Engr.

FRANZEN, EDWIN CHALMER (Junior), Tulsa, Okla. (Age 32) (Claims RCA 6.1) July 1931 to Sept. 1936 and July 1939 to date with U.S. Engr. Office as Jun. Engr., Asst. Engr., and (since July 1939) Associate Engr. being Asst. to Head of Design Sec.; in the interim Associate Engr., Office, Chf. of Engrs., War Dept., Washington, D.C.

GIFFT, HOWARD MERRILL, Ames, Iowa. (Age 32) (Claims RCA 8.0) March 1940 to date Instructor and graduate student, Iowa State Coll.; previously Engr., Iowa State Conservation Comm.; Asst. Director and Engr., Iowa ECW.

GOVER, JESSE, Cleveland Heights, Ohio. (Age 55) (Claims RCA 9.0) Nov. 1927 to Jan. 1929 Draftsman, and Feb. 1929 to date Designer, Office of Engr. of Structures, Erie R.R. Co., Cleveland, Ohio.

HALEY, GEORGE MALEN, Salt Lake City, Utah. (Age 50) (Claims RCM 21.5) Jan. 1935 to date County Surveyor and Engr., Salt Lake County, Utah.

HICKMAN, HAROLD CLARENCE (Junior), Detroit, Mich. (Age 32) (Claims RCA 4.8 RCM 2.4) July 1934 to April 1935 Inspector and May 1940 to date Jun. Engr., U.S. Engr. Office; in the interim Jun. Engr., U.S. Lake Survey.

HORWATH, THEODORE JOSEPH (Junior), Newark, N. J. (Age 32) (Claims RCA 2.1) Jan. to Aug. 1937 and Oct. 1937 to date Constr. Engr., M. W. Kellogg Co., New York City; previously Technical Foreman, Dept. of Agriculture (Conservation work), Trenton, N.J.

JEANS, ROBERT LEE, Watts Bar Dam, Tenn. (Age 30) (Claims RCA 3.0) March 1936 to date with TVA as Jun. Civ. Engr., and (since Aug. 1937) Administrative Asst. to Constr. Supt.; previously Engr., National Park Service; previously with W. E. Callahan Constr. Co.

JOHNSTON, JAMES EDWARD, Lincoln, Nebr. (Age 33) (Claims RC 2.7 D 0.3) June 1925 to Jan. 1927, Feb. 1927 to Jan. 1933, June 1933 to Sept. 1939 and June 1940 to date with Nebraska Dept. of Roads and Irrigation as Chainman, Rodman, Instrumentman, Jun. Project Engr., Eng. Draftsman, and (since June 1940) Traffic Office Engr., Div. of Traffic Eng.

KANE, FRANK, Knoxville, Tenn. (Age 34) (Claims RC 5.5) March 1936 to date with TVA as Recorder, Computer, Instrumentman, and (since Sept. 1937) Chf. of Party.

KOOMOS, GEORGE LOUIS (Junior), Vicksburg, Miss. (Age 32) (Claims RCA 2.0) Feb. 1937 to date with U.S. Engr. Office, as Jun. Eng. Aide, Asst. Eng. Aide, Draftsman, and (since Sept. 1939) Jun. Engr.; previously Rodman, Mississippi State Highway Dept., Hattiesburg, Miss.

LARKIN, KENNETH HOYT (Junior), Kansas City, Mo. (Age 32) (Claims RCA 2.0) Nov. 1936 to date Structural Designer, Burns & McDonnell Eng. Co.; previously Detailer and Designer and (7 months) Constr. Engr., Jones-Hettelsater Constr. Co., Kansas City, Mo.

LYSTER, LOUIS EVERETT, Cedar City, Utah. (Age 28) (Claims RC 6.0 D 3.1) Oct. 1935 to date with U.S. Dept. of Agriculture, SCS, as Asst. Agri. Engr., and (since Oct. 1939) Associate Agri. Engr.

MCCAIN, JOHN IRVING, JR. (Junior), Baton Rouge, La. (Age 32) (Claims RCA 3.3) March 1940 to date Civ. Engr., with W. Horace Williams, being Engr. on work for Standard Oil Co.; previously Bridge Draftsman, Louisiana Highway Comm.; Res. Engr., Billingsley Eng. Co., New Orleans, La.; Plant Civ. Engr., Bethlehem Steel Corporation, Shipbuilding Div., San Francisco, Calif.; Asst. Field Engr., American Bridge Co., Ambridge, Pa.

MINER, CHARLES JOHN (Junior), San Francisco, Calif. (Age 32) (Claims RCA 3.0) July 1929 to date Engr. and Estimator, Clinton Constr. Co. of California, Gen. Contrs.

MORTON, CHARLES MORSHEAD (Junior), Austin, Tex. (Age 32) (Claims RCA 2.9 RCM 4.3) June 1937 to date Constr. Engr. and Estimator, J. M. Odom, Gen. Contr.; previously Constr. Engr., Brown & Root, Inc., Austin, Tex.; Chf. of Party and Office Engr., RA.

NOLEN, JERRY AFTEN (Junior), Aberdeen Proving Ground, Md. (Age 27) (Claims RCA 2.8 RCM 1.3) July 1940 to date 1st Lieut., Ordnance Dept. Reserve, Engr. Div., Constr. Sec., U.S. Army; previously City Engr. and Supt. of Public Works, City of Seminole, Okla.; with Oklahoma WPA as Supervising Engr., Dist. 3, Area Engr., and Chf. Area Engr., Area No. 12.

NORSE, JOHN HRONYECZ, Chicago, Ill. (Age 38) (Claims RC 2.0 D 3.5) March 1923 to May 1924, July 1927 to Sept. 1933, summer 1936 and Feb. 1937 to date with Crane Co., as Tracer, Draftsman, Estimator, and (since Feb. 1937) in Hydraulics and Sanitary Research Laboratory as Hydr. Research Engr.

OLANDER, HARVEY CHESTER (Junior), Denver, Colo. (Age 32) (Claims RCA 3.5 RCM 1.8) Nov. 1933 to date with U. S. Bureau of Reclamation, as Jun. Engr., Associate Engr., and (since Dec. 1939) Engr.

O'NEIL, WILLIAM EDWARD, JR., Richmond, Va. (Age 34) (Claims RCA 3.5 RCM 4.6) April to June 1934 and Feb. 1935 to date with National Park Service as Eng. Foreman, Project Mgr., Asst. San. Engr., and (since July 1936) Associate San. Engr., Region 1.

PATTERSON, DONALD MACKELVY (Junior), Elmira, N.Y. (Age 32) (Claims RCA 6.7) July 1935 to Dec. 1937 and June 1940 to date Senior Eng. Foreman, National Park Service, U.S. Dept. of Interior; in the interim Res. Engr. and Asst. Constr. Supt., George M. Brewster & Son Constr. Co., and Special Engr. Agt., Div. of Investigations, PWA.

PICKERING, HAROLD PHILLIP, Cleveland, Ohio. (Age 34) (Claims RCA 2.8 RCM 2.1) April 1937 to date Drainage Products Engr., Republic Steel Corporation; previously Asst. Plant Engr., American Cyanamid Co., Brewster, Fla.; Instrumentman and Draftsman, Eng. Dept., Lakeland, Fla.

PINE, LYNN WILSON, Diablo, C.Z. (Age 30) (Claims RCA 2.1) April 1940 to date Asst. Engr., Special Eng. Div., The Panama Canal, Balboa, C.Z.; March 1934 to April 1935 and Nov. 1935 to Dec. 1939 Senior Draftsman, Jun. Engr., and Asst. Engr., U.S. Engr. Dept.

POOLE, ARTHUR EDWARD, Rockville Centre, N.Y. (Age 27) (Claims RCA 1.8 RCM 2.0) April 1940 to date Engr., Hallen Welding Service, Inc., Long Island City, N.Y.; previously with Madigan-Hyland, Cons. Engrs., New York City, successively as Transitman, Jun. Designer, Draftsman, etc., Welding, Steel, and Cable Inspector, and on general engineering.

SCHMULLER, FREDERICK MORRIS, New York City (Age 43) (Claims RCA 10.2 RCM 1.5) Jan. 1937 to date Asst. Engr. (Design), Dept. of Public Works; previously with Dept. of Plant and Structures, and Triborough Bridge Authority as Structural Steel Draftsman, Grade 4.

SEELAND, ELIAS, New York City. (Age 34) (Claims RCM 13.0) 1927 to 1928 and 1930 to date Inspecting Engr., Hildreth & Co.; in the interim Engr. with Elwyn E. Seelye, Engr.

SILVERT, MAC, Diablo Heights, C. Z. (Age 30) (Claims RCA 6.3 RCM 2.4) 1940 to date Associate Engr., Panama Canal; previously Engr. and Estimator, Columbia Constr. Co., Oakland, Calif.; Engr., Consolidated Bldrs. Inc., Mason City, Wash.; with Ben C. Gerwick, Inc., Gen. Contr., San Francisco.

SLATER, JAMES PRICE, Lincoln, Nebr. (Age 35) (Claims RCA 5.3) At present Asst. San. Engr., U.S. Dept. of Agriculture; 1938 to June 1940 student; previously Director of Sanitation and Malaria Control for State of Arkansas.

SMALL, ROLAND ROBERT (Junior), Brooklyn, N.Y. (Age 27) (Claims RCA 4.1) Feb. 1936 to April 1937 and Sept. 1939 to date Engr., P. T. Cox Constr. Co., New York City; in the interim Engr., Farub Foundation Corporation, Jun. Engr., Federal Power Comm., U.S. Civil Service, and Engr. with Arthur Gallow, Inc., all of New York City.

SMITH, MARVIN SCHADE, Gatun, C. Z. (Age 35) (Claims RC 7.7 D 1.2) Nov. 1939 to date Asst. Engr., The Panama Canal; previously Draftsman, Port of New York Authority, New York City; Project Engr., Middlesex County CWA and ERA.

SMITH, WILLIAM ELMER, New Dorp, N.Y. (Age 41) (Claims RCA 10.9) Sept. 1923 to date (except May 1932 to May 1934 furloughed) Engr., Constr. Dept., Baltimore & Ohio R.R. Co.

STEVENS, WILLIAM RONALD, St. Louis, Mo. (Age 36) (Claims RCA 7.5) June 1931 to date with Bethlehem Steel Co., as Cost Estimator, and (since Feb. 1937) Contracting Engr.

TCHERNOWITZ, JACK KALMAN (Junior), Brooklyn, N.Y. (Age 32) (Claims RCA 3.2) June 1935 to date Asst. Engr. (Designer), Madigan-Hyland, Cons. Engrs., Long Island City, N.Y.

THOMPSON, ISADORE (Junior), Redwood City, Calif. (Age 29) (Claims RCA 2.6 RCM 0.3) March 1937 to Jan. 1938 and June 1939 to date

Structural Designer and Inspector, L. S. Rosener, Engrs.; in the interim with City of San Francisco, Carl Zollner, Structural Engr., Ross, Calif., and with State of California as Asst. and Associate Structural Engr.

TRABAND, HAROLD FREDERICK, New York City. (Age 55) (Claims RC 15.0) Dec. 1917 to date with Dept. of Finance (Comptroller's Office), on audit engineering, Eng. Adviser to Comptroller, and (since 1935) Chf. Engr.

TUBUS, KENNETH OLSON (Junior), Tulsa, Okla. (Age 32) (Claims RCA 4.4 RCM 0.7) Oct. 1939 to date Asst. Engr., U.S. Engrs.; previously Designer Engr., Chas. W. Cole & Son, Fort Wayne, Ind.; Asst. Engr., Federal Power Comm., Chicago, Ill.; Designing Engr., Gen. Eng. Co., Portage, Wis.; Asst. State Hydr. Engr., and State Hydr. Engr., WPA.

WAY, NATHAN EMERAN, Knoxville, Tenn. (Age 37) (Claims RC 2.1 D 6.1) March 1936 to date Asst. Structural Engr., TVA; previously Chf. Draftsman, South Dakota State Bridge Dept., Pierre, S.Dak.

WRIGHT, CHARNER LEON, Yountville, Calif. (Age 42) (Claims RCA 6.9) July 1938 to date Associate Engr., California State Dept. of Public Works, Gen. Constr. Div. of Architecture; previously Constr. Supt., U.S. Gypsum Co., Gypsum, Ohio; Carpenter Foreman, Form Designer and Surveyor, Acme Brewing Co., Vernon, Calif.

ZUKOWSKI, VENCESLAUS JOSEPH, Chicago, Ill. (Age 36) (RCA 12.1) April 1927 to date with Greeley and Hansen as Draftsman, and (since June 1928) Structural Designer.

APPLYING FOR JUNIOR

BACON, GEORGE DONALD, Boston, Mass. (Age 28) (Claims RCA 0.8) Sept. 1937 to date with New England Power Service Co., Boston, Mass., as Draftsman, Inspector, and (since Oct. 1939) Structural Draftsman.

BARNETT, THOMAS CHARLES, San Jose, Costa Rica, C.A. (Age 22) 1939 B.S. in C.E., Univ. of Notre Dame; June 1939 to date Jun. Engr., Cia Bananera de Costa Rica.

BROG, JAMES CURRIE, Roanoke, Va. (Age 24) 1939 B.S. in Civ. Eng., Va. Pol. Inst.; Dec. 1939 to date Draftsman, Norfolk & Western Ry.

CARDWELL, EDWARD CHARLES, Chicago, Ill. (Age 29) April 1937 to date with Crane Co., as Draftsman in Plumbing and Heating, Eng. and Research Dept., and (since April 1940) Sales Engr., Water Works and Sewerage Dept.; previously Draftsman, Eng. Maintenance Dept., United Air Lines.

CARNIGLIA, JOSEPH WILLIAM, Sacramento, Calif. (Age 28) (Claims RCM 0.6) Dec. 1937 to date Jun. Engr., Dept. of Interior, Bureau of Reclamation; previously Jun. Engr., U.S. Dept. of Agriculture, Bureau of Agricultural Eng.; Jun. Aide, Univ. of California Irrigation Investigations.

CARROLLA, ROSS ROSARIO, Kansas City, Mo. (Age 26) Sept. 1937 to May 1938 and Sept. 1938 to May 1939 Graduate Asst., and Sept. 1939 to date Asst. Instructor, Mechanics Dept., Missouri School of Mines & Metallurgy; previously with S. G. Hayes Constr. Co., Chicago, Ill.

CORNELIUS, QUINCY CORLETT, JR., Marble Canyon, Ariz. (Age 23) 1939 B.S. in Civ. Eng., Univ. of Colo.; Dec. 1939 to date Jun. Engr., Water Resources Branch, U.S. Geological Survey.

DAVIS, ORAY MADISON, JR., Washington, D.C. (Age 25) Aug. 1940 to date Notekeeper and Rodman, PRA; previously with Hechinger Co.; with Northeastern Constr. Co., Winston-Salem, N.C., on general office work.

LORENZ, JOSEPH GEORGE, JR., Philadelphia, Pa. (Age 25) (Claims RCA 3.0) 1940 Diploma in Structural Eng., Drexel Inst. Tech. Evening School; July 1933 to date Draftsman, Quaker City Iron Works.

LUCHINI, JOSEPH WILLIAM, Santa Fe, N.Mex. (Age 25) 1938 B.S. in Civ. Eng., N.Mex. A. & M. Coll.; 1939 to date Dist. Cost Engr., New Mexico State Highway Dept.

MABRY, HENRY CLYDE, Decatur, Ala. (Age 23) (Claims RCA 1.0) 1939 B.S. in Civ. Eng., Ala. Pol. Inst.; 1939 to date with WPA as Supervisor, Gen. Supt., and at present Project Engr.

O'BRIEN, JOHN THOMAS, Waco, Tex. (Age 28) Dec. 1935 to date with SCS, USDA, Blacklands Experimental Watershed, as Asst. Eng. Aide, Jun. Hydr. Engr., Jun. and Asst. Hydr. Engr., and (since Jan. 1939) Asst. Hydr. Engr.

OWENS, EDWIN WATTS, Norfolk, Va. (Age 28) Jan. 1932 to Feb. 1933 and July 1936 to date with U.S. Engr. Office as Subinspector, Instrumentman, Subsurveyman, Inspector, and (since Feb. 1940) Civ. Eng. Aide, Permits, Examinations and Reports Sec.

PAXSON, LYLE LAREN, Topeka, Kans. (Age 28) (Claims RCA 0.6) 1939 B.S. in Arch. Eng., Univ. of Kans.; March 1936 to Sept. 1937 and summer 1938 Jun. Engr., Constr. Dept., and June 1940 to date Asst. Engr., Design Dept., Kansas State Highway Comm.; previously Engr., Phillips Petroleum Co., Bartlesville, Okla.

ROHDE, CARL, Portland, Ore. (Age 27) (Claims RCA 0.5) Jan. 1939 to date Jun. Engr., U.S. Engr. Office, Portland (Ore.) Dist.; previously Special Research Graduate Asst., Univ. of Illinois, Urbana, Ill.

TOTH, ALBERT STEVEN, Bellevue, Pa. (Age 23) 1939 B.C.E., Coll. of City of N.Y.; May 1940 to date Jun. Hydr. Engr., U.S. Geological Survey, Pittsburgh, Pa.

WARDWELL, FRANK PEIRSOL, Boston, Mass. (Age 26) June 1937 to date Engr., New England Power Association; previously with Frederick Snare Corporation.

1940 GRADUATES

ALA. POL. INST.
(B.S. in Civ. Eng.)

	Age
ADAMSON, CARL EDWIN	(21)
STOUGH, WILLIAM HARVEY	(22)

(B.S. in Mech. Eng.)

FOLMAR, JAMES MURPHREE	(24)

UNIV. OF ALA.
(B.S. in C.E.)

SANDLIN, PATRICK HERMAN, JR.	(21)

ARMOUR INST. TECH.
(B.S. in Civ. Eng.)

MACKEY, WILLIAM EDWARD	(25)

BROWN UNIV.
(S.B. in Eng.)

DEGNAN, JAMES SCOTT	(21)
DORR, STEPHEN EDWARD JR.	(22)

CALIF. INST. TECH.
(M.S. in Civ. Eng.)

CABELL, JOHN BELL	(24)
(Also 1937 B.S. in Civ. Eng., Va. Mil. Inst.)	
GANT, EDWARD VICTOR	(22)
(Also 1939 B.E., Vanderbilt Univ.)	
HALL, FORREST HOLT	(23)
(Also 1939 B.S. in Civ. and Irrigation Eng., Colo. State Coll.)	

UNIV. OF CALIF.
(B.S. in Civ. Eng.)

DODDY, JAMES JOSEPH	(24)

CARNEGIE INST. TECH.
(B.S.)

MOSITES, GEORGE ALVIN	(22)

CATHOLIC UNIV. OF AMERICA
(B. in Arch. Eng.)

WEINSTEIN, JESSE	(21)

THE CITADEL
(B.S. in C.E.)

BALDWIN, EDWIN HAROLD	(23)

UNIV. OF DETROIT
(B.C.E.)

ACETI, JOHN GABRIEL	(25)

DREXEL INST. TECH.
(B.S. in Civ. Eng.)

COZZENS, JOHN WALTER	(24)
KENNEY, JOHN DAVID, JR.	(23)
ROBIN, SIDNEY	(23)
SHAPIRO, IRVING	(23)
WILSON, ROBERT BROWN	(23)

HARVARD UNIV.
(M.S. in Civ. Eng.)

JOHNSON, STANLEY JOHN	(23)
(Also 1938 B.S., Armour Inst. Tech.)	

(M.S. in San. Eng.)

HEIPLE, LOREN RAY	(22)
(Also 1939 B.S., Iowa State Coll.)	

UNIV. OF ILL.
(B.S.)

BRASIC, FRANK	(25)
HALLDEN, OTTO SEBASTIAN	(26)
WUSTMANN, HERBERT FRANCIS	(26)

IOWA STATE COLL.
(B.S. in C.E.)

DURHAM, CHARLES WILLIAM	(23)
(Also 1939 B.S. in Gen. Eng.)	
STRENHILL, NILS KOLD	(25)

LEHIGH UNIV.
(B.S. in C.E.)

COX, ALFRED THOMAS	(25)
DELANY, AMBROSE GRAHAM	(22)

MANHATTAN COLL.
(B.C.E.)

BEAVER, JOHN FERRIS	(22)
DOUGHERTY, JAMES EDWARD JOSEPH, JR.	(22)
DOUGHERTY, WILLIAM JOSEPH	(21)
GRIFFIN, FRANCIS THOMAS	(21)
HECHT, LOUIS GERARD	(22)
JONES, JOSEPH VINCENT	(20)
MARTIN, ROBERT JOSEPH	(22)
MICCERI, JOSEPH JOHN	(23)
PUCCI, ROCCO NICHOLAS	(20)
ZIPP, WILLIAM PETER	(23)

MARQUETTE UNIV.
(B.C.E.)

HARDGROVE, GEORGE WILLIAM	(23)
LEOPOLD, GORDON ERWIN	(23)
MOKELKE, EUGENE ALBERT	(27)
PYZYNSKI, ARTHUR JOHN	(27)

UNIV. OF MD.
(B.S.)

FLETCHER, ARTHUR WHITNEY, JR.	(26)
GERBER, SIGMUND IRVIN	(23)
SLICER, WILLIAM ALEXANDER	(22)

MASS. INST. TECH.
(S.B.)

NEDELL, ROBERT SAMUEL	(21)
WITHERELL, PAUL WALKER	(22)

UNIV. OF MICH.
(B.S. in Civ. Eng.)

EDDY, ROBERT WILLIAM	(23)

UNIV. OF MISS.
(B.S)

JACO, LESLIE IRVING	(24)

COLL. OF THE CITY OF NEW YORK
(B.C.E.)

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VALLES, WILLIAM CECIL	(20)

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(B.C.E.)

EBERLIN, MONROE MARSHALL	(21)

PA. STATE COLL.
(B.S. in San. Eng.)

GRABER, RALPH CARL	(23)
SCHULTES, AUGUST CHARLES, JR.	(21)
YODER, WILLIAM ESSER	(22)

UNIV. OF PA.
(B.S. in C.E.)

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GIBSON, WILLIAM ROLAND	(21)

PURDUE UNIV.
(B.S.C.E.)

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(B.S. in C.E.)

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MILLER, TYRUS SHERMAN	(21)
WHITE, ROSSITER LAWRENCE	(23)

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(B.S. in Civ. Eng.)

BLACK, CHARLES DUNBAR	(23)

UNIV. OF TENN.
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MAGNESS, WILLIAM HOWARD	(24)

VA. MIL. INST.
(B.S.)

BROWN, EARL IVAN	(23)
DEADERICK, ROBERT HARDIN	(23)
WASDELL, RAYMOND VINCENT	(21)

UNIV. OF VA.
(B.S. in Civ. Eng.)

HAMMOND, BRADFORD CHAMPION	(24)

WASHINGTON UNIV.
(B.S.C.E.)

BREIHAN, ERWIN ROBERT	(21)

UNIV. OF WIS.
(B.S. in Civ. Eng.)

LEAMAN, DONALD DAVID	(22)
VROMAN, GEORGE MILES	(21)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Personnel Service, Inc., with offices in Chicago, Detroit, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 132 of the 1940 Year Book of the Society. To expedite publication, notices should be sent direct to the Personnel Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago, Detroit, or San Francisco follows the key number, when it should be sent to the office designated.

Construction

Civil Engineer; Assoc. M. Am. Soc. C.E.; 37; registered, New Jersey; 13 years in modern highway design and construction; heavy industrial construction and machinery installation; dredging; sales and consumer contact experience; creditable public speaker. Wishes to make permanent connection with manufacturers, engineer, or contractor in Metropolitan area. C-763.

Registered Professional Civil Engineer; Assoc. M. Am. Soc. C.E.; single; C.E. degree, 1920; continuously engaged in engineering and construction work; experienced both field and office work; more than 15 years experience in railroad, bridge construction, maintenance, valuation; one year highway bridge construction; 3½ years engineering experience, federal government; 10 years in responsible charge. Location and salary open. C-771.

Civil Engineer; M. Am. Soc. C.E.; registered in New York, North Carolina; 38; married; graduate civil engineer with legal education; 18 years experience, field and office; general engineering, including hydroelectric plants, earth and masonry dams, water works, sewers, paving, planning; location, design, estimating, supervision, construction, appraisals, expert witness, investigations, reports; now employed, federal government; desires responsible position with opportunity for advancement. C-774.

Construction Executive, Assoc. M. Am. Soc. C.E.; married; with intensive direct experience, every phase building construction, conception to occupancy, desires position heading construction department of large industry, desiring intelligent solutions to building problems at lowest annual costs; broad experience in many states; versatile, tactful, resourceful, energetic, adjustable; experienced reciprocal, industrial relations. Unquestioned integrity. Employed. Temperate zone. C-775.

Junior

Civil Engineer; Jun. Am. Soc. C.E.; 26; married; graduate C.E. (sanitary); 1 year U.S. Army, officer in Corps of Engineers; 1½ years water plant operation; 1½ years resident engineer on sewers and disposal plant construction; six months varied inspection and office work; 3 months Diesel plant operation. C-764.

Civil Engineer; Jun. Am. Soc. C.E.; 26; married; B. Sc. C.E., Royal Technical College, Denmark. Specialization: harbor building, soil mechanics, foundations. During college, 8 months in machine shop; 6 months Copenhagen Harbour Authority designing quays, bridge work; 1½ years general construction, designing foundations, reinforced concrete, steel. Available on short notice. C-765.

Civil Engineer; Jun. Am. Soc. C.E.; 24; single; B.S., University of California, 1939; specialized in structural engineering, some graduate work in structural analysis and photoelasticity; 2 months highway engineering; 13 months flood control work and hydraulics. Employed at present but desires structural engineering position. Salary secondary to good opportunity. Location immaterial. C-767.

Civil Engineer; Jun. Am. Soc. C.E.; 25; married; B.S.C.E., Duke University, 1938; 2 years experience in charge of laboratory procedure and research soil stabilization; desires permanent position in soil mechanics or stabilization research. Available on short notice to employer. C-768.

Civil Engineer; Jun. Am. Soc. C.E.; 25; married; B.S.C.E., Newark College of Engineering; 10 months state hydraulic engineer, flood control; 9 months draftsman and statistician, marketing survey; 4 months transitman-party chief, property line survey; 9 months assistant, college civil engineering department; 8 months draftsman, insulation engineering. Desires permanent position; location immaterial; available on suitable notice to employer. C-769.

Part-Time Civil Engineer; Jun. Am. Soc. C.E.; 26; married; B.S.C.E., New York University, 1934; working on master's degree; 6 years varied experience on topographic surveying, flood control, hydraulics, hydrology, and construction. Now employed; desires evening and week-end employment in estimating, surveying, tutoring, or kindred subjects. Location New York City. C-770.

Civil Engineer; Jun. Am. Soc. C.E.; 28; married; 9 years experience in earth construction field; last 5 years on construction of water conservation works; has had considerable administrative responsibility on medium-sized projects, including material procurement, timekeeping, payrolls, and cost accounting. Seeks opportunity to work into established organization; location immaterial. C-772.

Civil Engineer; Jun. Am. Soc. C.E.; 24; single; B.S. from Drexel Institute of Technology, 1939; 9 months varied experience in construction prior to graduation; one years experience in highway construction including inspection and drafting since graduation. Desires position with opportunity for advancement in construction field. Will go anywhere. C-773.

Municipal

For Tropical Service: Civil Engineer; M. Am. Soc. C.E.; 56; over 35 years experience in municipal engineering, including design and construction of sewage disposal and water filtration plants. Railroad location and construction; mine development; building design and construction, including equipment. Now employed as executive in consulting firm. C-766.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room will be found listed here. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

Bildwort Deutsch Technische Sprachhefte. 1. Ingenieurbau. 32 pp., 1.50 rm. 2. Heben und Fördern. 36 pp., 1.50 rm. VDI-Verlag, Berlin, 1940. Illus., diagrs., 8½ × 6 in., paper.

These pamphlets are intended to assist engineers who wish to increase their ability to read technical German publications. Each pamphlet contains a descriptive article upon some subject, in German, with numerous drawings upon which the German names are written, so that the drawings act as vocabularies. Subject indexes are provided. The first of the pamphlets is on structural engineering; the second on hoisting and conveying machinery.

Cadiz to Cathay, the Story of the Long Struggle for a Waterway Across the American Isthmus. By Miles P. Du Val, Jr. Stanford University Press, Stanford University (California); Humphrey Milford, London, 1940. 554 pp., illus., tables, 9 × 6 in., cloth, $5.

To give the historical background of the long struggle for control of the transisthmian canal routes and a comprehensive account of the dramatic events that led to the grant of the Canal Zone to the United States has been the aim of the author of this interesting book. The story, based upon personal letters and official documents of the leaders, is especially timely today from the standpoint of the international situation as well as from an engineering viewpoint.

Civil Engineering Handbook, 2 ed. By L. C. Urquhart. McGraw-Hill Book Co., New York, 1940. 877 pp., illus., diagrs., charts, tables, 9 × 6 in., flexible leather, $5.

The principal purpose of this work is to provide the practicing engineer with a compact, comprehensive book, to which he can refer when confronted with a problem outside a specialized field. Civil engineering is covered in ten sections: surveying, railway, and highway engineering, mechanics of materials, hydraulics, stresses in framed structures, steel design, concrete, foundations, sewerage and sewage disposal, water supply, and purification. Each section is written by a well-known authority. Fundamental theory is stressed and tabular material is kept to a minimum. The new edition has been revised to conform with present practice.

City Manager Government in the United States. By Harold A. Stone, Don K. Price, and Kathryn H. Stone. Public Administration Service, Chicago, 1940. 279 pp., tables, 9 × 6 in., cloth.

The authors of this volume spent some time in each of eighteen carefully selected cities, observing the life of the community and government in action. They have written monographic reports on nine of the cities visited, which give a realistic account and penetrating analysis of the plan in actual operation under varying local conditions.

Elements of Utility Rate Determination. By J. M. Bryant and R. R. Herrmann. McGraw-Hill Book Co., New York, 1940. 464 pp., charts, tables, 9½ × 6 in., cloth, $4.50.

The purpose of this book is to cover the field of public-utility rate determination, service, and discrimination from the viewpoint of the engineer and manager rather than from that of the lawyer or economist. The authors discuss reasons for the regulation of utility rates, describe the methods used to accomplish such regulation, and outline the practical limitations involved. Reference is made to many actual cases.

General Engineering Handbook, 2 ed. Edited by C. E. O'Rourke. McGraw-Hill Book Co., New York, 1940. 1120 pp., illus., diagrs., charts, tables, 8½ × 5½ in., flexible leather, $4.

The purpose of this reference book is to present in one volume the fundamental data relating to all branches of engineering. The data are arranged in nineteen sections: mathematics; mathematical tables; physical tables; engineering materials; theoretical mechanics; hydraulics; structural theory and design; plain and reinforced concrete; foundations; topographical and geodetic surveying; route surveying and earthwork; highways; municipal sanitation; machine elements; pumps, compressors, and hydraulic turbines; engineering thermodynamics; heating and air conditioning; fundamentals of electrical engineering; electrical measurements. This edition has been thoroughly revised and rearranged.

Geology for Civil Engineers, as Related to Highway Engineering. By D. G. Runner. Gillette Publishing Co., Chicago, 1939. 299 pp., illus., diagrs. charts, maps, tables, 9 × 6 in., cloth, $5.

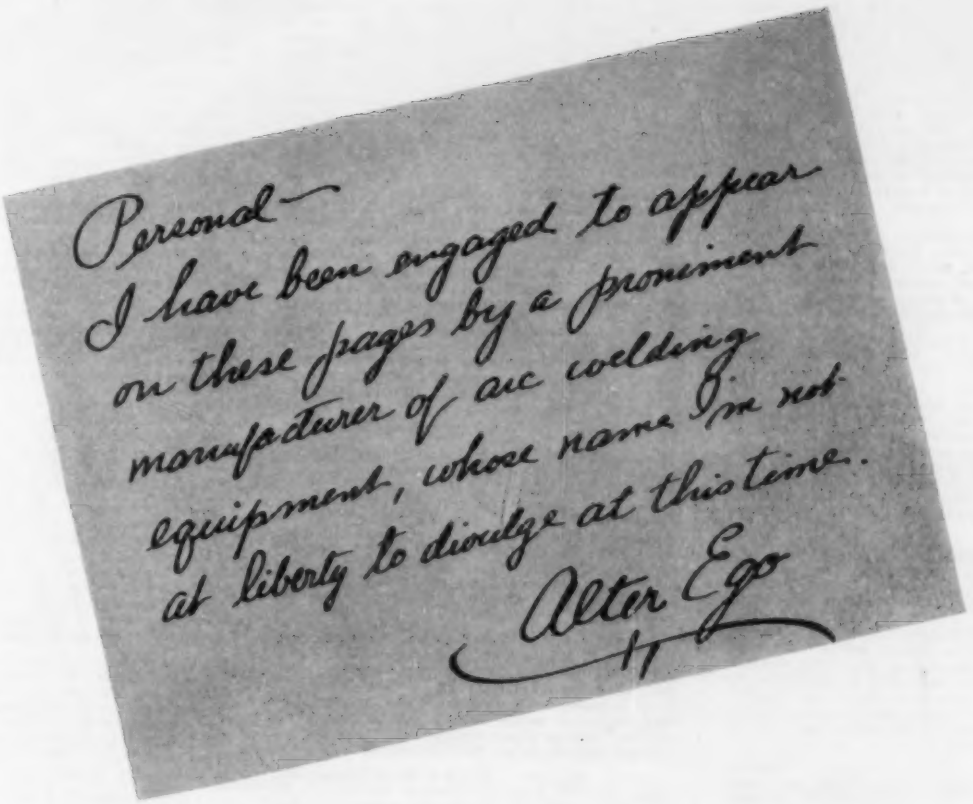
This book, the outgrowth of a series of articles published in *Roads and Streets*, is intended as a textbook for students of highway engineering. It discusses the origin, formation, and characteristics of the various rocks, and describes the road-building properties of the principal types in considerable detail. Chapters are devoted to clays, blast-furnace slag, rock weathering, sand and gravel, soils and soil tests, and low-cost road surfaces. Glossaries of geological and highway terms, lists of state geological and highway offices, standard tests, and a list of works on geology are appended.

Records and Research in Engineering and Industrial Science, a Guide to the Production, Extraction, Integrating, Storekeeping, Circulation, and Translation of Technical Knowledge. By J. E. Holmstrom. Chapman & Hall, London, 1940. 302 pp., diagrs., charts, tables, 9 × 5½ in., cloth, 15 s.

The author first discusses the nature and methods of technical science and its practical applications. This is followed by descriptions of the character, objects, and activities of experimental and technical organizations and societies. The succeeding chapters cover the various ways of searching technical literature, methods of indexing and filing, the expression and transmission of ideas, and the translation of foreign languages, with considerable reference to the author's personal experience. The qualifications and opportunities of the technician are also discussed.

Surveying, Theory and Practice, 3 ed. By R. E. Davis and F. S. Foote. McGraw-Hill Book Co., New York, 1940. 1032 pp., illus., diagrs., charts, maps, tables, 8 × 5 in., flexible leather, $5.

While primarily intended as a college textbook, this work is also intended to give, in a single volume, a sufficiently comprehensive treatment to be of value to engineers and surveyors. For this purpose, the more advanced phases of the subject are discussed, and methods used on extensive surveys are described and evaluated. The new edition has been rewritten, and among the new material added is a chapter on photogrammetric surveying.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CURRENT PERIODICAL LITERATURE

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Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own file, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

HIGHWAY. Economics of Highway Bridges. P. S. Nolan. *Surveyor*, vol. 97, no. 2520, May 10, 1940, pp. 415–417. Discussion of comparative economy of several types of highway bridges, including plate girder spans, deck bridges, truss bridges, continuous spans, rigid frame bridges, arch bridges, movable bridges, etc.

HIGHWAY, GREAT BRITAIN. Moor Bridge, Nottingham, F. M. Little. *Civ. Eng.* (London), vol. 35, no. 407, May 1940, pp. 129–133. Design and construction of highway bridge, 110 ft long, across river Leen and railroad tracks at Nottingham, England, consisting of two welded steel girder spans encased in concrete and one concrete slab span; cost £40,000.

PIERS, RECONSTRUCTION. Displaced Bridge Pier Jacked Back Into Position. *Ry. Eng. & Maintenance*, vol. 36, no. 7, July 1940, pp. 450–452. Description of scheme used to right masonry center pier of swing span on New York Central Railroad, damaged when struck by barge.

PLATE GIRDER, RECONSTRUCTION. Reconstruction of Katugastota Bridge, Ceylon. *Engineering*, vol. 149, no. 3870, Mar. 15, 1940, pp. 269–272, supp. plate. Original bridge consisted of three clear spans, with two masonry piers, each 14 ft wide at top; illustrated description of scheme for reconstruction; new main steel under girders are 64 ft long overall; departure from ordinary Warren girder form made by introduction of vertical members; joints in girders so arranged as to permit fabricated lengths to be sent to site and lifted and riveted in position from below road decking.

PONTOON, WASHINGTON. Moorings for Lake Washington Bridge. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 82–85. Design and construction of 64 anchor cables holding in position pontoon structures of Lake Washington floating bridge at Seattle, Wash.; all cables slope at about 22 deg with horizontal and are set with varying tensions depending on cable length; tension will have to be adjusted in shorter cables for fluctuations of lake level which may reach 3 ft; arrangement for jacking and fastening cables; zinc coating requirement for individual wires in pontoon anchor cables.

PONTOON, WASHINGTON. Seattle's Floating Bridge, H. W. Young. *Compressed Air Mag.*, vol. 45, no. 2, Feb. 1940, pp. 6072–6078. Report on construction of concrete pontoon highway bridge over Lake Washington at Seattle, Wash., previously described from various sources.

STEEL. Unusual Features of Design and Construction Mark New Bridge Over Mississippi. *Ry. Age*, vol. 108, no. 26, June 29, 1940, pp. 1172–1178. Illustrated description of new 5-span structure at Baton Rouge, La., carrying single track and two highways, which involved deep foundations and balanced cantilever erection; entire project to cost $8,500,000; river spans provide underclearance of 65 ft above high water; deck construction; deep substructures; sand island method of construction used; steel erection; special falsework; careful balance maintained.

STEEL, WELDING. All-Welded Road Bridge at Clayhithe. *Engineering*, vol. 149, no. 3875, Apr. 19, 1940, pp. 409–411 and 414. Example of application of welding to bridge construction provided by bridge built about 4½ miles northeast of Cambridge; it consists of two portal frames with solid webs, supported at ends on hinged bearings placed at 65-ft centers; interesting feature of erection was prestressing of main frames.

STEEL, WELDING. Welded Rigid Frames, European Style, F. L. Plummer. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 91–93. Design and construction of all-welded rigid frames in approaches to Cleveland's new Main Avenue Bridge; details of transition section between girders and supporting columns that occur between short side spans and 70-ft center span; eliminating biaxial or triaxial stresses that might cause "brittle" failure; details of web plates; floor system; railing and lights; saving by welding.

STEEL TRUSS, KROTZ SPRINGS, LA. Simple Truss Bridge Lengthened Into Long Cantilever, H. J. Engle. *Eng. News-Rec.*, vol. 125, no. 1, July 4, 1940, pp. 22–24. Method of lengthening Missouri Pacific Railroad bridge at Krotz Springs, La., by separating two of existing 300-ft simple truss spans by 720 ft of new steel work in form of twin cantilevers having common anchor arm, 300-ft spans being hung from ends of new cantilevers; removal of two old piers; construction of two new deep caisson piers of special design.

SUSPENSION, HUTSONVILLE, ILL. Self-Anchored I-Girder Suspension Bridge, C. H. Gronquist. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, pp. 57–59. Description of new 2-lane highway bridge over Wabash River at Hutsonville, Ill., featuring 350-ft main span; open strand cable construction and continuous girders; fabrication and erection; details of main piers.

WOODEN. Timber Bridges, H. I. Kaegi. *Civ. Eng.* (London), vol. 35, no. 406, Apr. 1940, pp. 102–105. Description of several European timber bridges, with comments on principles of their design and construction. From Int. Rev. on Timber Utilization.

BUILDINGS

CONSTRUCTION, CALIFORNIA. Houses Built to Last 60 Years. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, pp. 150–153. Description of Carmelitos housing project in North Long Beach, Calif., which will provide 607 family dwelling units, averaging 4⅓ rooms; designs and choice of materials based on 60-year life expectancy; quantity production of pre-cast floor joists and new type of "wrinkled" metal floor forms; foundation excavation; concrete stairways.

OFFICE BUILDINGS, DESIGN. Engineering Features of World's Most Modern Office Building, A. C. Clausen. *Nat. Engr.*, vol. 44, no. 1, Jan. 1940, pp. 12–15 and 20. Office building of S. C. Johnson & Co., Racine, Wis.; modern features included bands of glass tubing to provide lighting, heating pipes laid in floor, and complete summer and winter air conditioning system.

STEEL, WELDED. Welded Rigid-Frame Machine Shop, F. Jackson. *Welder*, vol. 12, no. 73, Mar.-Apr. 1940, pp. 60–63. New machine shop at Stockton Forge works, of welded construction is described; general dimensions; advantages of welded construction; erection; purlins; columns; wind bracing; crane track girders; welding.

STEEL WELDED. Welding Cuts Cost of Air Lines Terminal, L. Grover. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 94–97. Brief description of air line terminal opposite Grand Central Terminal in New York City; details of all-welded construction of heavy structural frame saving 100 tons of steel and simplifying complicated connections; details of direct welding of web members of heavy trusses eliminating most gusset plates; shop and field methods of steel frame construction.

CITY AND REGIONAL PLANNING

COMPARISON OF PLANS. Superblock vs. Gridiron. *Arch. Forum*, vol. 73, no. 1, July 1940, pp. 66–67; see also *Am. City*, vol. 55, no. 8, Aug. 1940, pp. 72–73. Discussion of comparative costs and advantages of superblock over gridiron layout of dwellings; with special reference to cost of public utilities.

CONCRETE

AGGREGATES. Einfluss der Feinsandzugabe auf Betoneigenschaften, P. Francmanis. *Zement*, vol. 29, nos. 12 and 13, Mar. 21, 1940, pp. 145–148, and Mar. 28, pp. 158–160. Influence of fine sand admixture on properties of concrete; results of experiments on strength, plasticity, and impermeability of concrete mass lead to conclusion that these properties are greatly improved by addition of fine sand.

AGGREGATES, SEPARATION. Detecting Unsound Chert in Aggregates, C. E. Wuerpel. *Eng. News-Rec.*, vol. 124, no. 19, May 9, 1940, pp. 80–82. Detection and elimination of unsound concrete aggregates containing cherts by flotation in heavy liquids; relationship between apparent specific gravity, absorption, and soundness of chert gravels; chert flotation equipment.

CONSTRUCTION. Job Problems and Practice. *Am. Concrete Inst.—J.*, vol. 11, no. 6, June 1940, pp. 685–688. Discussion of following problems: Compressed air jets as means of placing concrete; strength of concrete frozen after placing; strength of low-heat concrete at standard age of 28 days.

CONSTRUCTION, EQUIPMENT. Die Einrichtung von Grossbetonbaustellen, W. Nakoni. *Zement*, vol. 29, nos. 1, 2, and 3, Jan. 4, 1940, pp. 7–11; Jan. 11, pp. 20–23; and Jan. 18, pp. 32–35. Illustrated description of equipment for large-scale concrete construction, such as is used in construction of dams, locks, etc.; storage and allocation of materials; details of mixers and concrete handling equipment; equipment used in construction of shaft lock at Anderten, Saal Valley dam at Hohenwarte, and double lock near Wedtlenstedt, all in Germany.

CONSTRUCTION, FORMS. Forming Circular Concrete Surfaces with Plywood. *Concrete*, vol. 48, no. 4, Apr. 1940, pp. 20 and 33. Various advantages to be gained from use of plywood for concrete form work as compared with ordinary form lumber.

CONSTRUCTION, FORMS. Find Way to Eliminate Voids Under Forms on Concrete Surface, C. O. Crane. *Concrete*, vol. 48, no. 3, Mar. 1940, pp. 5–6 and 47. Form lining of absorptive insulating board removes excess water and permits escape of entrapped air bubbles; U.S. Bureau of Reclamation has specified such lining for two jobs soon to be started. Before Highway Engrs. Conference at Univ. of Colo.

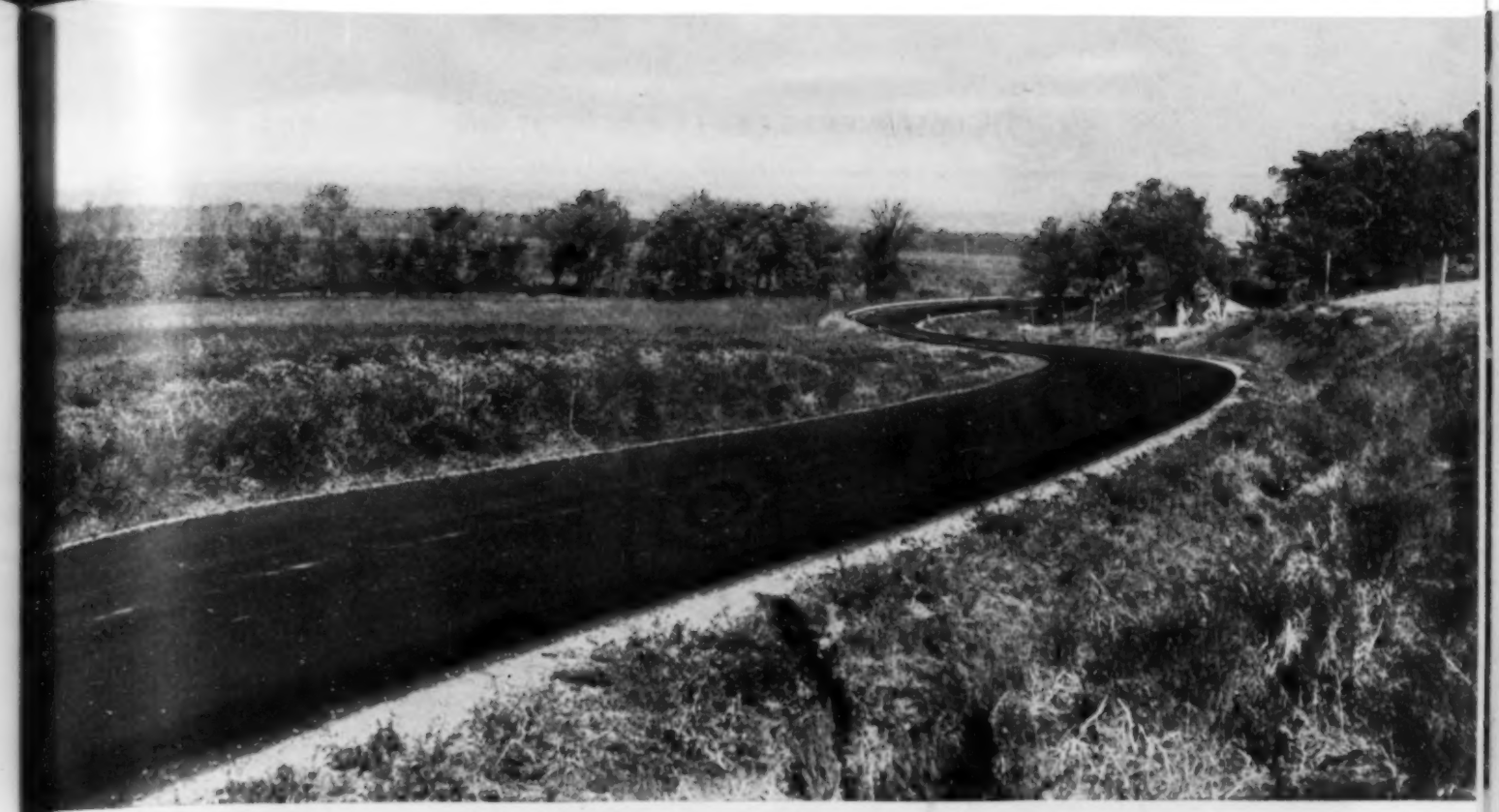
CONSTRUCTION, PUMP PLACING. Pumpcreting at Grand Coulee, H. Blonk. *Pac. Bldr. & Engr.*, vol. 46, no. 22, June 1, 1940, pp. 35–38. Design and operation of installation for pumping concrete at rate of 60 cu yd per hour through quarter of mile of 8-in. seamless steel pipe for construction of lining of tunnels and penstocks of Grand Coulee Dam power house.

CONSTRUCTION, VIBRATING. Les derniers progrès dans la vibration et pervibration du beton, T. Makcheeff. *Travaux*, vol. 24, no. 89, May 1940, pp. 141–148. Review of 20 years of progress in development of processes for vibrating concrete; study of reasons retarding adoption of concrete vibrating practice; transmission of vibration in concrete mass; expulsion and aspiration of air in vibrated concrete; effect of vibrating on shrinkage of concrete; economy of vibrated concrete.

DAMS, CALIFORNIA. Preparing Aggregate for Shasta Concrete. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 100–101. Layout and equipment for preparation of 10,000,000 tons of sand and gravel aggregates for Shasta Dam in California; flow sheet for Redding plant, where four sizes of rock and three grades of sand are delivered to 9.6-mile belt conveyor which transports aggregate to dam.

HANGARS, Aeroplane Hangar. *Engineer*, vol. 169, no. 4400, May 10, 1940, p. 443. Brief illustrated description of large reinforced concrete hangar built in south of France; it is 265 ft long by 163 ft wide; height is 39 ft 4 in.; it is covered by concrete roof supported on series of trusses, spanning whole distance without any intermediate support; main feature of structure consists of 7 rood trusses of lattice type, having span of 265 ft 4 in. and rise of 32 ft 10 in.

HIGHWAY SYSTEMS, PENNSYLVANIA. Paving Pennsylvania Turnpike. *Eng. News-Rec.*, vol. 125, no. 1, July 4, 1940, pp. 25–29. Description of equipment and methods used in rushing paving of about 140 miles of 4-lane Pennsylvania



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OIL WELL CEMENTING. Use of Bulk Cement in Wells. *Petroleum Engr.*, vol. 11, no. 11, July 1940, p. 74. Notes on equipment for handling cement in bulk, developed by company supplying cement in San Joaquin Valley, Calif.; hoppers hold 1,000 sacks of cement; when job requires larger quantity, two hoppers are placed at well.

SHIPS. Revived Interest in Ships of Concrete Recalls World-War Experience. *Concrete*, vol. 48, no. 5, May 1940, pp. 5–6. Several outstanding facts stated on basis of experience gained by Emergency Fleet Corporation during World War, and performance of concrete ships built by Corporation.

SHRINKAGE. Stress Increases in Compressive Steel Under Constant Load Caused by Shrinkage, G. A. Maney and M. B. Lagaard. *Am. Concrete Inst.—J.*, vol. 11, no. 6, June 1940, pp. 541–552. Discussion of data from various sources showing that continued deformations in compressive steel of reinforced concrete members, under constant loads, are caused by shrinkage and not by "plastic flow" or "creep"; effect of shrinkage deformation on compressive steel stresses under sustained load; experimental evidence of warping.

SPECIFICATIONS. Impracticable Gravel Specifications, I. Warner. *Rock Products*, vol. 43, no. 3, Mar. 1940, pp. 40–42. Screening difficulties in meeting Simplified Practice Recommendation for coarse aggregates point to necessity for changes in specifications. From discussion of practicability of Simplified Practice Recommendation for Coarse Aggregates, U.S. Bur. Standards R163-39, before Nat. Sand & Gravel Assn.

SUBWAY CONSTRUCTION. Distribution and Placing Concrete on Chicago's Subway. *Concrete*, vol. 48, no. 6, June 1940, pp. 3–4 and 39. Method of placing concrete in construction of Chicago's first subway system, now about 63% completed; pumping through pipe-line has been found most practical method of distribution of concrete.

TESTING, FREEZING. Resistance of Concrete to Freezing and Thawing, W. H. Wood. *Concrete*, vol. 48, no. 5, May 1940, p. 8. Conclusions drawn from results of research by Texas State Highway Dept., Austin, Tex., on durability of aggregates and their concrete-making properties. Before Nat. Sand & Gravel Assn.

VIADUCTS. Special Features Reduced Cost of This Highway Subway. *Ry. Age.*, vol. 108, no. 19, May 11, 1940, pp. 814–816. Three-span, double-track underpass constructed on Canadian National at Coaticook, Quebec; contributing factors in promoting economy of structure are pre-cast concrete slab deck of main span, type of pier construction employed, and use of second-hand deck plate girders in flanking or approach spans; center span consists of pre-cast reinforced concrete slabs, 38 ft in length; two approach spans are of second-hand deck plate girders 28 ft 8 in. long.

WALLS. Ueber die Isolierung senkrechter Betonwaende mit Naturasphaltmastix, H. Neumann. *Bauwelt*, vol. 11, no. 1, Jan. 5, 1940, pp. 1–6. Review of modern methods of waterproofing of vertical concrete walls with natural asphalt mastic.

CONSTRUCTION INDUSTRY

COSTS. *Engineering News-Record* Construction Costs 1940 Edition. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, 70 pp. between pp. 85–212. Collection of data from *Engineering News-Record*, 1939, including many previously indexed items; building cost indexes; railroad cost index; public utility construction index; Lambert's utility cost trends; prices of construction materials; construction wage rates; road-building costs; small house costs; costs of municipal buildings in New York City; costs of USHA housing; costs on welded buildings; costs of clay sewer pipe; unit bid prices.

DAMS

CONCRETE, FORMS. Wood Panel Forms for Building Concrete Dams—I, H. P. Maxton. *Construction Methods*, vol. 22, no. 6, June 1940, pp. 42–44, 93–94, 96, and 98–99. First of series of articles dealing with design, manufacture, and handling of wood panel forms for construction of concrete dams, with special reference to experience of Tennessee Valley Authority; breakdown of concrete costs; mass concrete formwork cost; cooperation in design; pressure of fresh concrete on forms; effects of vibration; allowable stresses in timbers.

CONCRETE GRAVITY, CALIFORNIA. Shasta Dam Construction Layout. *Eng. News-Rec.*, vol. 125, no. 1, July 4, 1940, pp. 18–21. Outline of construction layout for placing 5,700,000 cu yd of concrete on site of Shasta Dam in northern California; concrete is moved out in two-compartment hopper cars via circular track, whence it can be discharged into 8-cu yd buckets on loading dock under seven radial cableways, reaching out over entire dam and power-house area from top of 460-ft steel tower.

CONCRETE, TEXAS. Historic Austin Dam Rebuilt, C. McDonough. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, pp. 52–55. Reconstruction of concrete gravity and concrete deck Austin Dam, on Colorado River, from remnant of old dam which had failed for second time in 1915; solidification of dam foundation; cost of reconstruction $3,200,000.

CONVEYORS, BELT—DAM CONSTRUCTION. World's Longest Conveyor Belt. *Western Construction News*, vol. 15, no. 6, June 1940, pp. 193–197. Design and construction of 9.5-mile conveyor belt which will deliver 10,400,000 tons of aggregate from Redding to stock piles at Shasta Dam, California; conveyor frame; major units of equipment; operation; description of automatic control; protective braking and four regenerative motors described by H. Schrader and L. O. B. Lindstrom.

EARTH, CALIFORNIA. Earth Handling Equipment Operations at Hansen Dam. *Western Construction News*, vol. 15, no. 6, June 1940, pp. 202–204. Review of excavation and earth-moving work carried out by fleet of 15 scraper units; construction of Hansen rolled earth-fill dam in southern California; methods of loading; maintenance and servicing.

EARTH, OREGON. Bids are Called on Cottage Grove Dam, H. W. Andersen. *Pac. Bldr. & Engr.*, vol. 46, no. 22, June 1, 1940, pp. 28–29. Engineering features of proposed earth-fill dam of Willamette Valley project, Oregon, which will be approximately 2,100 ft long and 92 ft maximum height; drilling and broaching; compaction specifications.

EARTH, RHODE ISLAND. Small Dam for Big Job, C. A. Frye. *Eng. News-Rec.*, vol. 124, no. 21, May 23, 1940, pp. 62–64. Design and construction of small earth-fill dam for 45-acre reservoir on Target Brook at Cranston, R.I., including flashboard spillway and fish ladder.

EMBANKMENTS, SEEPAGE. Application of Flow Figures to Computation of Seepage Through Earth Fills, R. Muller. *Water & Sewage*, vol. 78, no. 7, July 1940, pp. 14–20 and 50–52. Theoretical mathematical analysis of forces acting on water-bearing stratum through ground water; stability of slopes; approximate methods for determination of stability of banks which are subject to influence of water.

EROSION. Experimental Investigation of Protective Filters, G. E. Bertram. *Harvard Univ.—Graduate School Eng.—Publ., No. 267*, Soil Mechanics Series, No. 7, Jan. 1940, 21 pp., 50 cents. Results of systematic investigation carried out in Soil Mechanics Laboratory of Harvard University for determination of principles of design of sand and gravel filters for protection of foundations downstream of river weirs and open dams; conclusions are equally applicable to problems of filter layers surrounding wells, blind drains in highway embankments, drains beneath basement floors in buildings, etc.

HYDRAULIC FILL, OHIO. Shell Material in Dams of Miami Conservancy District, C. H. Eiffert. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, p. 71. Results of mechanical analysis of sand and gravel in outer sections of Englewood, Germantown, and Huffman dams of Miami Conservancy District in Ohio.

LANDSLIDES. Problems of Slide Control Handled at Grand Coulee. *Western Construction News*, vol. 15, no. 6, June 1940, pp. 204–206. Review of methods used by U.S. Bur. of Reclamation in controlling earth slides in connection with construction of Grand Coulee Dam, including system of drainage wells through slide connected by series of tunnels in bedrock, frozen earth dam, and drainage shaft heading number of drifts through water-bearing clay; excavation details; water flow in drifts; equipment used.

PENSTOCKS, LININGS. Fabrication of Dam Penstock and Pump Inlet Linings for Grand Coulee. *Steel*, vol. 106, no. 25, June 17, 1940, pp. 44–46 and 62. Steel plates up to 3 1/4 in. thick are fabricated into lining sections near dam site in shop erected especially for this work; unusual fabricating and testing procedures employed are described.

RESERVOIRS, CONCRETE. Huge Reinforced Concrete Foundation Slab Is Feature of Big Reservoir. *Concrete*, vol. 48, no. 3, Mar. 1940, pp. 3–4 and 44. Reinforced concrete foundation slab, 10 ft deep and 102 ft in diameter, is feature of Mount Washington Reservoir, now under construction in Cincinnati; inside diameter of reservoir is 60 ft and depth to overflow level is 141 ft 6 in., giving reservoir capacity of 3,000,000 gal.

RESERVOIRS, CONCRETE. Water Storage at Ashland Aids Treatment of River Supply, J. P. Brownstead. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, p. 69. Use of concrete-lined ravine at Ashland, Ky., as raw water basin, holding 10 days' supply to even out variations in quality of Ohio River water, and thus reduce abnormally high treatment costs.

RESERVOIRS, LEAKAGE. Reservoir Leakage Almost Nil Through Bonus Incentive, R. E. Koon. *Water Works Eng.*, vol. 93, no. 10, May 8, 1940, pp. 614–618. Description of special design and workmanship for prevention of leakage from new 15,000,000-gal covered concrete slab reservoir in Eugene, Ore.

RESERVOIRS, SANITATION. Disinfecting Waterworks Fill Before Placing on Embankment. *Eng. & Contract. Rec.*, vol. 53, no. 17, Apr. 24, 1940, pp. 15 and 18. Equipment and methods used in disinfecting of shale and tunnel spoil before it is deposited on banks of West Branch Reservoir from which New York City obtains part of its present water supply; materials are disinfected by spraying with commercial bleaching powder, containing 35% of available chlorine.

FLOOD CONTROL

BANK PROTECTION. Bank Protection in California, G. A. Tilton, Jr. *Better Roads*, vol. 10, no. 5, May 1940, pp. 23–26. Review of California practice in construction of rock and concrete revetments, also fencing, for prevention of erosion and flood damage to road banks; notes on principal types of such construction, including cost data.

CALIFORNIA. Floods of December 1937 in Northern California, H. D. McGlashan and R. C. Briggs. *U.S. Geol. Survey—Water-Supply Paper 843*, 1939, 497 pp., 60 cents. Tabulated rainfall and streamflow data for December 1937 flood which affected about two-thirds of California.

LEVEES, CONSTRUCTION. Larger levees for Lake Okeechobee. *Eng. News-Rec.*, vol. 124, no. 19, May 9, 1940, pp. 64–67. Report on enlargement and strengthening of 14 miles of levee along southeast side of Lake Okeechobee in Florida; using shell conglomerate and limestone rock dredged from lake bottom; experiments in protecting slopes against erosion.

NEW ZEALAND. Hawke's Bay Flood, 23rd-25th April 1938, A. P. Grant. *New Zealand Instn. Engrs.—Proc.*, vol. 25, 1938–1939, pp. 55–64, (discussion) 73–91, supp. plates. Data on unusual rainfall and flood of April 23–25, 1938, in Hawke's Bay section on east coast of North Island, New Zealand, resulting in discharges as high as 2,700 cu ft per sec per sq mile for watershed of 3.4 sq miles and 250 cu ft per sec per sq mile for watershed of 900 sq miles.

RIVERS, REGULATION. Dredging Tennessee River, C. H. Vivian. *Compressed Air Mag.*, vol. 45, no. 5, May 1940, pp. 6138–6142. General description of program designed to control flow of Tennessee River so as to prevent floods and improve navigation; 650-mile stretch will be converted into series of pools created by chain of nine dams, six of which are already in place; dredging program involves deepening at upstream ends of pools, to provide 9-ft navigation prescribed in TVA Act; drilling, blasting, and dredging equipment and practice.

SIPHONS. Lifting River Over Levee, J. D. Andrews, Jr. *Eng. News-Rec.*, vol. 125, no. 1, July 4, 1940, pp. 39–42. Description of siphon installation recently completed at Marked Tree, Ark., consisting of three steel siphons of 9-ft diameter capable of discharging, 2,600 cu ft per sec, designed by U.S. Army Engineers as part of work on St Francis River flood control project; performance data showing that siphon carrying water over levee has discharge coefficient equal to 0.97.

FLOW OF FLUIDS

FLOW METERS. Recording Water-Flow Meter, E. C. Childs. *J. Sci. Instruments*, vol. 17, no. 4, Apr. 1940, pp. 93–94. Meter for recording instantaneous rate of flow of water from outfall pipes of agricultural drainage systems; two ranges have so far been constructed, with reasonable linearity of scale, dealing with rates of flow up to about 40 liters per min; record of water flow from mole drain in heavy land is shown, illustrating need for such recorder in many drainage experiments.

FOUNDATIONS

BRIDGE PIERS, CONSTRUCTION. Unusual Equipment Speeds Caissons and Piers. *Eng. News-Rec.*, vol. 125, no. 1, July 4, 1940, pp. 30–33. Construction entirely by floating plant, of highway bridge piers across Raritan River at Perth Amboy, N.J., sunk as much as 85 ft to rock as pneumatic caissons, and extending 125 ft in air; river pier shafts; delivering mix; construction costs.

DRILLING, CORE. Two TVA Core-Drill Jobs, P. H. Kline. *Compressed-Air. Mag.*, vol. 45, no. 2, Feb. 1940, pp. 6083–6087. Description of two rock-drilling jobs in Tennessee Valley Authority for construction of locks at Chickamauga Dam and exploration of type of Watts Bar Dam; boring of holes 36 in. in diameter for foundation-bearing columns averaging 50 ft deep; exploratory drilling conducted midstream of Tennessee River from floating-rig assembly; modern Calyx drill; floating core drill.

OIL WELL DRILLING, EQUIPMENT. Rotary-Rig Foundations in Gulf Coast Marshes, N. Williams. *Oil & Gas J.*, vol. 39, no. 13, Aug. 8, 1940, pp. 42–43. As depth of drilling, with consequent use of heavier equipment, increases in Gulf Coast marsh-located operations, companies are giving more study to design and construction of foundations; advantages of steel substructures; plan of newly designed piling foundation for drilling rigs.

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PILE. Design of Pile Foundations Using Piles of Varied Lengths, H. E. Eckles. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, pp. 70–71. Outline of methods of design of pile foundations for retaining walls or other walls with extensive loadings, using piles of unequal length and spacing proportional to their required loading.

PILE DRIVERS. Pile Driving Leads 135 ft Long. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, pp. 56–57. Description of San Francisco pile driver with leads 135 ft long, consisting of 35-ft structural steel top section put in place as unit, after timber portion had been erected.

PILES, BEARING CAPACITY. Pile Bearing Increased by Close Driving, W. Z. Lidicker. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, pp. 172–174. Test of close driving on pile-bearing capacity; pile spacing of 3 ft increased load 60%; supplementary tests indicating effect of earth surcharge in increasing bearing power of lower layer in which piles are footed; results of timber pile tests; steel-bearing pile tests.

PILES, CONCRETE. Concrete Pile Bents Removed Intact by Crane-Operated Rig. *Construction Methods*, vol. 22, no. 6, June 1940, pp. 46–49. Use of specially designed crane-operated hoisting equipment and jet points for extracting, transporting, and re-installing 407 existing four-pile bents for boardwalk relocation at Coney Island, New York; water supply for jetting.

QUAYWALLS, DESIGN. Anwendungen der Erddrucktheorie bei der Berechnung von Spundwaenden und Kaimauern, H. G. Schuette. *Bauingenieur*, vol. 21, no. 14/16, Apr. 15, 1940, pp. 105–124. Application of modern theory of earth pressures to design of bulkheads and quaywalls; friction within earth masses; distribution of resistance in earth masses; design of anchor structures; design of steel sheet-piling in bulkheads.

ROADS AND STREETS, CONSTRUCTION. Road Construction on Peat Foundations, A. H. D. Markwick. *Roads & Road Construction*, vol. 17, no. 203, Nov. 1939, pp. 343–345. Summary of published information on road construction on peat foundations; nature of peat; peat as foundation; pile foundations; fascines; direct construction on peat; excavation; displacement from beneath superimposed embankment by gravity, blasting, and by water jetting. Bibliography.

SOILS, TESTING. Exploration of Soil Conditions and Sampling Operations, H. A. Mohr. *Harvard Univ.—Graduate School Eng.—Publ., No. 269*, Soil Mechanics Series, No. 9, Feb. 1940, 53 pp., $1.25. Outline of methods of field investigation of soils, including peat, organic silt, mud, dock mud, muck, river bed ooze, hardpan, shale, etc.; methods of underground exploration for foundation purposes; borings; test pits; test rods and sounding rods; geophysical methods; analysis of typical examples.

HYDRAULIC ENGINEERING

LABORATORIES, CANADA. New Hydraulic Laboratory of National Research Council, J. B. Bryce and K. F. Tupper. *Eng. J.*, vol. 23, no. 7, July 1940, pp. 317–319. Plan and equipment of new National Research Council Hydraulic Laboratory at Ottawa, Ontario; details of constant level tank, venturi meters, experimental flume, etc.

RESEARCH. Annual Report of Work Done During 1937–1938, C. C. Inglis, A. R. Thomas, and D. V. Joglekar. India. *Central Board of Irrigation—Research Publ., No. 1*, IHR 1.38–450 1939, 85 pp., supp. plates. Price Rs 7–8 of 11s 6d. Description of Poona Irrigation and Hydrodynamic Research Station; review of research on many local irrigation, flood control, and hydraulic problems, as well as research on such general problems as use of models for elucidating flow problems, exclusion of silt from canals, eradication of water weeds, seepage from canals, failing aprons, etc.

WEST AFRICA. Le port de Pointe-Noire (A. E. F.). *Travaux*, vol. 24, no. 89, May 1940, pp. 123–129. Description of new port of Pointe-Noire on Atlantic Coast of French Equatorial Africa; design and construction of rubble-mound and concrete breakwaters; results of hydraulic model tests of breakwaters.

HYDROELECTRIC POWER PLANTS

BOLIVIA. Hydroelectric Construction in Bolivia, J. K. Sexton. *Eng. J.*, vol. 23, no. 6, June 1940, pp. 256–263. Development of Bolivia; hydroelectric developments in Choquetanga and Chatamarca valleys, having total capacity of 63,000,000 kw-hr annually; design and construction of earth dams, canals, etc., using primitive means of transportation; construction materials and supplies; labor. Before Eng. Inst. Canada.

SOUTH CAROLINA. Santee-Cooper Construction Operations. *Eng. News-Rec.*, vol. 124, no. 21, May 23, 1940, pp. 46–47. Progress report on initial stage of construction of dams of Santee-Cooper project in South Carolina.

HYDROLOGY AND METEOROLOGY

EARTHQUAKES, CALIFORNIA. Imperial Valley Earthquake. *Bldg. Standards Monthly*, vol. 9, no. 6, June 1940, pp. 6–15. Symposium of three reports on Imperial Valley (California) earthquake of May 18, 1940: From Scientific Point of View, F. P. Ulrich; Building Inspector's Point of View, C. N. Dirlam; Review of Damage to Buildings, H. Colling.

EARTHQUAKES, CALIFORNIA. Imperial Valley Earthquake. *Western Construction News*, vol. 15, no. 6, June 1940, pp. 219–220. Records of effects of Imperial Valley earthquake, which occurred on May 18, and caused extensive damage in towns of Brawley, Imperial, El Centro, and Calexico, Calif., and surrounding territory, discussed at meeting of Structural Engineers Assn. of Northern California.

RUNOFF. Preliminary Analyses of Runoff Data from Edwardsville Project, W. W. Horner. *Agric. Eng.*, vol. 21, no. 6, June 1940, pp. 223–226. Analysis of runoff data for three small watersheds and terraced area near Edwardsville, Ill.; determination of infiltration capacity values. Before Am. Soc. Agric. Engrs.

TIDES, AUSTRALIA. Tides at Fremantle, Western Australia, A. Bennett. *Dock & Harbour Authority*, vol. 20, no. 235, May 1940, pp. 158–160. Study of tides at Fremantle, Western Australia, including author's original investigations; tide records; range of tide; times of high and low water; prediction of tidal levels.

WATERSHEDS, INFILTRATION. Construction, Operation, and Use of North Fork Infiltrometer, P. B. Rowe. *U.S. Dept. Agric.—Flood Control Coordinating Committee Miscellaneous Publ., No. 1*, Feb. 1940, 64 pp. Construction, operation, and use of North Fork Infiltrometer developed primarily for determining infiltration capacities of soils on large areas by sampling methods; infiltration studies made at watercycle and soil experimental installations at North Fork, Calif.; relations of rainfall intensity and duration, surface runoff, surface detention, and depression storage to infiltration. Bibliography.

INLAND WATERWAYS

RIVERS, ITALY. Ricerche Idrografiche nel Delta del Po, M. Visentini, Italy. *Ministero dei Lavori Pubblici—Ufficio Idrografico del Po—Publ., No. 14*, vol. 2, 1940, 175 pp. figs., diagrs., charts, supp. plates. Report on climatological and hydrological study of delta of river Po, Italy; historical notes on Po River delta since ancient times; review of streamflow studies of Po River tributaries; research on silt transportation and salinity of Po delta; temperature studies. Orographic changes in Po River delta. Bibliography.

IRRIGATION

BRIEF HISTORY. Influence of Mechanical Mind on Development of Irrigation Through Ages, E. B. Ball. *Water & Water Eng.*, vol. 42, no. 524, May 1940, pp. 180–184. Review of primitive and modern African and Asiatic mechanisms for lifting and storage of irrigation water.

HUMID REGIONS. Determining Index of Supplemental Irrigation and Its Application, F. E. Staebner. *Agric. Eng.*, vol. 21, no. 6, June 1940, pp. 215–217. Outline of methods developed by Soil Conservation Service for determining irrigation needs in Michigan, on basis of normal rainfall and severity of drought. Before Am. Soc. Agric. Engrs.

IDAHO. Idaho Project—Plan to Develop Irrigation and Power on Snake, R. J. Lyman. *Western Construction News*, vol. 15, no. 6, June 1940, pp. 207–210. Outline of reclamation project for development of storage on Snake River, near Hagerman, Idaho, with irrigation canal system to deliver water to about 700,000 acres of land, with correlated production of 130,000 kw of hydroelectric power; proposed rock-and-earthfill dam to cost about $15,000,000; Snake River siphon.

MONTANA. Construction Features of Glendive Unit, D. R. Burnett. *Reclamation Era*, vol. 30, no. 5, May 1940, pp. 125–128. Construction of canals, siphon, wasteways, drops, etc., for irrigation of 17,000-acre unit of Buffalo Rapids Project, Montana.

TEXAS. Supply Canal for Lower Rio Grande. *Eng. News-Rec.*, vol. 124, no. 19, May 9, 1940, pp. 90–91. Outline of proposed Rio Grande River irrigation project, including $60,000,000 canal and reservoir, to carry 3,000 cu ft per sec from diversion at Rincon 168 miles to Brownsville, Tex., to remedy threatened water shortage land and water supply conditions.

LAND RECLAMATION AND DRAINAGE

MEMPHIS, TENN. Malaria and Drainage Ditches Combined Effectively. *Am. City*, vol. 55, no. 7, July 1940, pp. 62–63 and 74. Design of open ditches and reinforced concrete box culverts for combined drainage and malaria control in Memphis, Tenn.

MATERIALS TESTING

CONCRETE. Test Wear Resistance of Concrete Floors with Portable Machine. *Concrete*, vol. 48, no. 4, Apr. 1940, pp. 5–6. Wear resistance of concrete, and how such resistance is influenced by variations in mix, by different types and grading of aggregate, by *C/W* ratio, and by factors such as methods of finishing, dust coats, and liquid surface treatments, has been determined through series of tests conducted at National Bureau of Standards with portable machine developed especially for purpose.

CONCRETE MIXING. Application of Some of Newer Concepts to Design of Concrete Mixes, W. M. Dunagan. *Am. Concrete Inst.—J.*, vol. 11, no. 6, June 1940, pp. 649–684. Experimental study leading to basic solution for problem of proportioning concrete mixes by demonstrating how certain of older ideas and more recent theories fit into common picture; use of Weymouth equation to compute ideal gradings; estimation of preliminary mixes prior to trial batches when workability is important factor; application of principles to mix design and mix adjustment. Bibliography.

PORTS AND MARITIME STRUCTURES

WASHINGTON, D.C. Improvement of Washington Channel Waterfront, Washington, D.C. *Dock & Harbor Authority*, vol. 20, no. 236, June 1940, pp. 177–181. Report on recent improvements of waterfront of Potomac River in Washington, D.C., including construction of commercial piers and yachting facilities; typical arrangement of yacht stalls.

RAILROADS, STATIONS, AND TERMINALS

RAILROAD CONSTRUCTION, CALIFORNIA. 30-Mile Line Diversion on S. P. Involves Heavy Work. *Ry. Age*, vol. 108, no. 25, June 22, 1940, pp. 1108–1113. Description of project under way in upper Sacramento River Valley designed to circumvent Shasta Dam Reservoir, which required 12 tunnels, 8 bridges, and extensive grading.

ROADS AND STREETS

AIRPORT RUNWAYS. Airport Surfacing, G. H. Beddoe. *Can. Aviation*, vol. 13, no. 5, May 1940, pp. 20–21, 34 and 39. Practical and experimental discoveries in treatment of soils and surfaces for runway construction.

BITUMINOUS. Tar Carpets, G. H. Fuidge. *Roads & Road Construction*, vol. 18, nos. 206 and 207, Feb. 1940, pp. 39–40, and Mar., pp. 60–61. Study of factors affecting behavior of thin bituminous road surfacing; effect of properties of binder; viscosity characteristics of tar; adhesion of tar to stone; changes in tar on exposure; design of carpet mixture; coarse and medium texture tar carpets; fine texture carpets; hot process carpet; method for control of tar carpet manufacture. Before Pub. Works, Roads & Transport Congress.

BITUMINOUS. Tests on Bituminous Mixtures Made with Stone Screenings, A. T. Goldbeck. *Crushed Stone J.*, vol. 15, no. 2, Apr.-May 1940, pp. 3–9. Stone screenings when mixed with bituminous material are found to make exceptionally stable surfacing for roads, parking areas, airports, driveways, and sidewalks.

CANADA. Trans-Canada Highway Officially Designated Route Coast to Coast, W. M. Dickson. *Roads & Bridges*, vol. 78, no. 6, June 1940, pp. 12–13 and 110–111. Description of route of nearly completed Trans-Canada Highway from Halifax to Vancouver.

CONSTRUCTION. Recent Highway Engineering Works in Union of South Africa, B. H. Knight. *Roads & Road Construction*, vol. 18, no. 210, June 1940, pp. 118–120. Methods and equipment used in carrying out recent road construction program in South Africa, including roads of water-bound and cement-bound macadam.

CURVES. Safe Sharp Curve, E. L. Stewart. *Eng. News-Rec.*, vol. 125, no. 5, Aug. 1, 1940, p. 175. Description of curve layout intended to cut down accidents on small-radius road bends.

EARTH BORING MACHINES. Cutting Down on Pavement Cuts. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 98–99. Description of horizontal earth drill for boring holes from 4 to 14 in. in diameter, used in Chicago suburbs when installing gas pipe and conduits under streets, roads, trees, shrubbery, and lawns; drill works from small cut made at edge of pavement or lawn, pushing series of detachable augers through any type of ground except solid limestone.

ELEVATED. Report of Committee on Elevated Highways. *Am. Road Bldrs.' Assn.—Bul., No. 64*, mtg. Jan. 29-Feb. 2, 1940, 16 pp. Committee report reviewing recent American practice in planning and construction of elevated highways; advantages and disadvantages of elevated highways; estimated costs of superhighways.

EXPERIMENTAL. Experimental Cement-Soil Levee Road, L. B. Wilby. *Military Engr.*, vol. 32, no. 184, July-Aug. 1940, pp. 260–262. Construction and performance of stretch of experimental road, approximately 1¼ miles long, located on top of levee in vicinity of Ravenswood, La., connecting State Highways Nos. 1 and 41, so that these roads could continue to be used when Morganza Floodway is in operation; costs; possibilities of use of cement soil stabilization for military purposes.

ICE CONTROL. Use of Common Salt for Removal of Ice on Concrete Roads, A. R. Collins. *Roads & Road Construction*, vol. 18, no. 209, May 1940, pp. 98–101. Report on experimental studies made at Road Research Laboratory of Department of Scientific and Industrial Research

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of Great Britain on effect of sodium chloride on road surfaces; effect of salt treatments on rate of disintegration of frozen concrete; effect of age of specimen, method of treatment, water-cement ratio, and type of aggregate on damage caused by salt. Bibliography.

INTERSECTIONS. Design of Stoney Creek Traffic Circle, F. S. Hutton. *Roads & Bridges*, vol. 78, no. 7, July 1940, pp. 18–19 and 54. Design and construction of traffic circle on Queen Elizabeth Way at Hamilton, Ontario, underpassing single-track railway line that cuts across its diameter; bulk excavation; drainage system; concrete pavement.

PENNSYLVANIA. Streamlined Mountain Thoroughfare. *Better Roads*, vol. 10, no. 7, July 1940, pp. 13–14 and 31–32. Design and construction features of Pennsylvania Turnpike described in many previously indexed articles.

RAILROAD CROSSINGS, GATES. Gates at Seven Alton Crossings. *Ry. Age*, vol. 108, no. 9, Mar. 2, 1940, pp. 410–412. Complete 24-hour protection for entire town of Lincoln, Ill., accomplished by closing five crossings and installing short-arm gates with signals at remaining seven.

ROAD MATERIALS, GRAVEL. Chemical Treatment of Chert-Gravels for Use in Base-Course Construction, E. A. Willis and P. C. Smith. *Pub. Roads*, vol. 21, no. 4, June 1940, pp. 65–68 and 80–81. Results of circular track tests of Alabama chert; gravels treated with hydrated lime and tar; rate of surface displacement of track sections under traffic; comparison of densities obtained by laboratory compaction tests and by testing on circular track.

SOIL CEMENT. Soil-Cement Road Building in Hilly Country, J. E. Wood. *Concrete*, vol. 48, no. 6, June 1940, p. 6. Unusual features of soil cement road construction project in Carroll County, Md., described.

SANITARY ENGINEERING

MOSQUITO CONTROL, CANADA. Mosquito Control in Ottawa District, A. E. Hay and C. R. Iwinn. *Water & Sewage*, vol. 78, no. 7, July 1940, pp. 12–13 and 48–50. Review of mosquito control methods and activities in Ottawa district between 1936 and 1939; annual cost of mosquito control.

SEWERAGE AND SEWAGE DISPOSAL

BUFFALO, N.Y. Sewage Treatment at Buffalo, New York, G. E. Symons, C. R. Velzy, and B. Morey. *Am. Inst. Chem. Engrs.—Trans.*, vol. 36, no. 3, June 25, 1940, pp. 325–344. Description and diagram of new sewage treatment works; flow sheets of sewage treatment process and solids disposal process; data on sewage treatment and solids disposal for 1939; data interpreted from standpoint of operating results; abnormal conditions of operation occurring during year; application of data to solids balance; difficulties of such application. Bibliography.

CIRCLEVILLE, OHIO. Two-in-One Chemical Plant for Strawboard Wastes, Sewage, E. F. Leist. *Sewage Works Eng. & Mun. Sanitation* (formerly *Mun. Sanitation*), vol. 11, no. 7, July 1940, pp. 330–332. Description of new chemical precipitation sewage disposal plant of Circleville, Ohio, treating both domestic sewage and strawboard wastes, having total capacity of 3 mgd; method of treatment; difficulties in operation of plant; strawboard waste problems.

EXCELSIOR, MINN. Small-Town Plant for Sewage Treatment. *Am. City*, vol. 55, no. 8, Aug. 1940, pp. 35–37. Description of new sewage disposal plant of Excelsior, Minn., serving population of 1,200, including comminutor and clarifier, and trickling filter; sludge digestion and disposal; odor control.

METHODS OF TREATMENT AND DISPOSAL. Treatment and Disposal of Plant Effluent. *Sewage Works Eng. & Mun. Sanitation* (formerly *Mun. Sanitation*), vol. 11, no. 7, July 1940, pp. 341–342. Discussion by sewage disposal plant superintendents of methods of treatment and disposal of sewage plant effluent, maximum and minimum flow of diluting water, effect of character of stream on treatment processes.

OSHKOSH, WIS. Chemical Treatment at Oshkosh, R. W. Frazier. *Sewage Works Eng. & Mun. Sanitation* (formerly *Mun. Sanitation*), vol. 11, no. 7, July 1940, pp. 324–326. Description of new 6-mgd sewage disposal plant at Oshkosh, Wis., designed to provide grit removal and primary settling; addition of floc-forming chemicals, mixing and flocculating apparatus; final settling and chlorination of effluent and influent; flash mixing and flocculation; gas engine generators; summary of operation and equipment.

PLANTS, OPERATION. Improving Operation of Small Sewage Treatment Plant, C. G. Weber. *Water Works & Sewerage*, vol. 87, no. 7, July 1940, pp. 309–313. Report on 4-year experience in operation of 3-mgd sewage disposal plants of Annapolis, Md.; chlorination improvements; sludge pumping; sludge disposal; elutriation experiences; savings in chemical costs; sludge mixing arrangement; "Annapolis" automatic sludge-weight-recorder.

SEWERS, MAINTENANCE AND REPAIR. Sewer Servicing in New York, C. W. Williams. *Sewage Works Eng. & Mun. Sanitation* (formerly *Mun. Sanitation*), vol. 11, no. 7, July 1940, pp. 327–329. Review of New York City practice in routine cleaning of sewers and trapped catch basins; sewer cleaning machines; flushing with hose; sewer repair gangs.

TRICKLING. Trickling Filters, M. Levine. *Water & Sewage*, vol. 78, no. 7, July 1940, pp. 10–11 and 42–47. Experiments with trickling filters at Iowa Engineering Experiment Station; data for full-size plants designed on basis of these experiments to treat concentrated packing house wastes; effect of bottom ventilation on purification of creamery wastes; effect of dosing cycle on purification by coarse-grained trickling filter and on distribution of rates of discharge wastes from filter; comparison of efficiency of various systems of trickling filters.

STRUCTURAL ENGINEERING

ALIGNMENT CHARTS. Mathematics of Alignment Chart Construction Without Use of Determinants, J. R. Griffith. *Ore. State College—Eng. Experiment Station—Bul. No. 12*, Nov. 1939, 39 pp. Determination of alignment chart characteristics by basic equations and solution of two equations simultaneously; method is confined to those equations that are adjustable to type of expression resulting in parallel-scale monograph; coordinates and devices for obtaining rectangular coordinates, logarithmic coordinates and reduction diagram; examples of application. Bibliography.

CHEMICAL EQUIPMENT. Selecting Materials of Construction, H. L. Maxwell. *Chem. & Met. Eng.*, vol. 47, no. 7, July 1940, p. 471. Author offers suggestions for guidance of engineers who are faced with necessity of selecting materials from which to fabricate piece of equipment.

FLOORS, BASES. Flooring Bases and Underlays, J. G. Robertson. *India-Rubber J.*, vol. 99, nos. 25 and 26, June 22, 1940, pp. 586–588, and June 29, pp. 599–600, (discussion) 604–605. Notes on surface conditions of base apart from its soundness; various types of bases and underlay described, including concrete bases, wood flooring, compound concrete floors, underlays, asphalt, magnesite composition, and latex rubber underlays; rubber laying on stairs and on ships.

FRAMED STRUCTURES, STRESS ANALYSIS. Nouveaux essais sur modèles de noeuds rigides, F. Campus. *Ossature Métallique*, vol. 9, no. 3, Mar. 1940, pp. 125–142. First part of report on theoretical studies and laboratory tests of rigid connections of joints in frame structures such as trusses, bents, etc. Bibliography. (To be continued.)

RIGID FRAME BRIDGES, HINGES. Investigation of Rigid Frame Bridges, Part III, R. W. Kluge. *Ill. Univ.—Eng. Experiment Station—Bul. No. 322*, vol. 37, no. 29, Mar. 12, 1940, 33 pp. 40 cents. Results of tests of structural behavior of various types of hinges adaptable to concrete rigid frame bridges, their elastic and ultimate strength under vertical loads and under inclined loads, their resistance to angular rotation; effect of plastic flow on resistance to rotation.

ROOF TRUSSES. Timber Trusses Support Roofs Over 2½ Acres of Shops. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, p. 85. Features of 72 timber trusses with spans 50 to 130 ft long used in new shipyards at Tacoma, Wash.

TRUSSES, ALUMINUM ALLOY. Tests of 28-Foot Span Aluminum Alloy Trusses, R. L. Templin, E. C. Hartmann, and H. N. Hill. *Aluminum Company of America—Aluminum Research Laboratories—Tech. Paper No. 3*, 1940, 40 pp. Report on static load and vibration tests, within elastic range, on pair of aluminum alloy trusses; comparison of measured and calculated deflections, primary stresses and secondary stresses under various panel point loadings; effect of changing gusset plate thickness; behavior of single-angle web members compared to that of double-angle web members; comparison of measured and calculated frequency of vibration.

SURVEYING

ROADS AND STREETS. Banking of Dual Carriageways, H. Criswell. *Roads & Road Construction*, vols. 17 and 18, nos. 203, 204, 205, 206, 207, 208, 209, and 210, Nov. 1939, pp. 331–334; Dec., pp. 358–360; Jan. 1940, pp. 4–7; Feb., pp. 26–29; Mar., pp. 50–52; Apr., pp. 72–74; May, pp. 95–97; and June, pp. 114–116. Outline of five methods of design of superelevations for dual roadways; numerical examples; tables of relative and real gradients of channels; vertical curves at intersections of various channel gradients; offsets from tangents to curves; effect of vertical curves on cross-fall of carriageways; setting out; verges, footpaths, and cycle tracks; drainage.

TUNNELS

CONCRETE LINING. Labor Cost in Lining Small Tunnel with Concrete Pump. *Concrete*, vol. 48, no. 5, May 1940, pp. 3–4. Notes on placing concrete by pipe line in construction of half-mile section of monolithic concrete sewer tunnel, 54 in. in diameter, in Gary, Ind.; description of equipment and general procedure.

ELECTRIC LIGHT AND LIGHTING. Daytime Lighting for Tunnel Entrances. *Eng. News-Rec.*, vol. 125, no. 1, July 4, 1940, p. 43. Chart, prepared by General Electric engineers at Nela Park, showing day-time lighting requirements for tunnel entrances to give eyes chance to readjust themselves to comparative darkness after having been accustomed to several thousand foot-candles of daylight.

SUBWAYS, CHICAGO, ILL. New Chicago Underground Railway, R. Butler. *Civ. Eng.* (London), vol. 35, no. 407, May 1940, pp. 147–150. Design and construction of first 8-mile line of new Chicago subway; description of prefabricated tubes for river crossing; soil sampling; primary lining; central batching plant; shields.

VEHICULAR NETHERLANDS. Le tunnel sous la Meuse à Rotterdam, J. P. Van Bruggen. *Travaux*, vol. 24, nos. 85 and 87, Jan. 1940, pp. 1–10, and Mar. pp. 78–86; see also *Civ. Eng.* (London), vol. 35, no. 406, Apr. 1940, p. 96. Report on design and construction of 4-lane vehicular tunnel, 1,070 m long, under new Meuse River at Rotterdam, Netherlands; geological conditions; features of ventilating towers, escalators for pedestrian tunnel, etc.; construction of tunnel sections on dry land, their launching and sinking onto river bed; features of foundations of ventilating structures; tunneling in river banks; tunnel services; mechanical and electric equipment.

VEHICULAR, UTAH. Construction of Bingham-Copperfield Vehicular Tunnel, L. S. Breckon. *U.S. Bur. Mines—Information Cir. No. 7128*, July 1940, 12 pp. Description of methods and equipment used in constructing 6,975-ft vehicular tunnel, with dimensions inside concrete lining 16 ft 4 in. wide and 10 ft high above finished roadway surface, topped by arch sprung to radius of 8 ft 2 in.; grade is 6.43%; tunnel is for one-way traffic, diverting route away from Utah copper open-cut mine ore body; it also carries water, sewage, pipe lines, and electric cables.

WATER SUPPLY, NEW YORK. Billion Gallons Not Enough, C. M. Clark. *Eng. News-Rec.*, vol. 124, nos. 15, 16, 19, and 23, Apr. 11, 1940, pp. 83–85; Apr. 25, pp. 54–58; May 9, pp. 84–86; and June 6, pp. 67–70. Illustrated description of Delaware project, New York City, including three reservoirs and 85-mile rock tunnel aqueduct; laying out route of tunnel to provide interconnection with Catskill and Croton systems and assure good rock conditions and flexible operation; design considerations affecting aqueduct construction; shaft and tunnel lining; roof support; grouting; drawing off water through shafts.

WATER PIPE LINES

SIPHONS, STEEL. Siphon Self-Supporting in Long Spans, P. J. Bier. *Eng. News-Rec.*, vol. 124, no. 25, June 20, 1940, pp. 60–63. Description of concrete pipe and welded steel pipe irrigation siphon, 10 ft 3 in. in diameter, 1,723 ft long, across Shoshone River at Cody, Wyo., featuring unsupported pipe span 150 ft long; details of ring girders for preventing distortions in pipe shell at points of support; fabrication of steel pipe; radiographic examination of field welds; testing siphons for leakage.

WATER RESOURCES

SURFACE, MASSACHUSETTS. Westfield River. *Mass. State Planning Board—Drainage Basin Study, No. 6*, 1939, 84 pp., figs., tables, diagrs. Study of geography and hydrology of Westfield River watersheds in western Massachusetts; review of interrelated water problems such as supply, flow, power, and pollution and their relations to recreation, land use, transport, and other aspects of state plan; Westfield River floods and their frequencies.

SURFACE, TEXAS. Summary of Records of Surface Waters of Texas, 1898–1937, C. E. Ellsworth. *U.S. Geol. Survey—Water-Supply Paper 850*, 1939, 154 pp., 20 cents. Records of stream-flow at gaging stations and other points of Texas streams collected by U.S. Geological Survey and other agencies; tables of minimum and maximum discharges showing unprecedented records of flood flow. Bibliography.

WATER TREATMENT

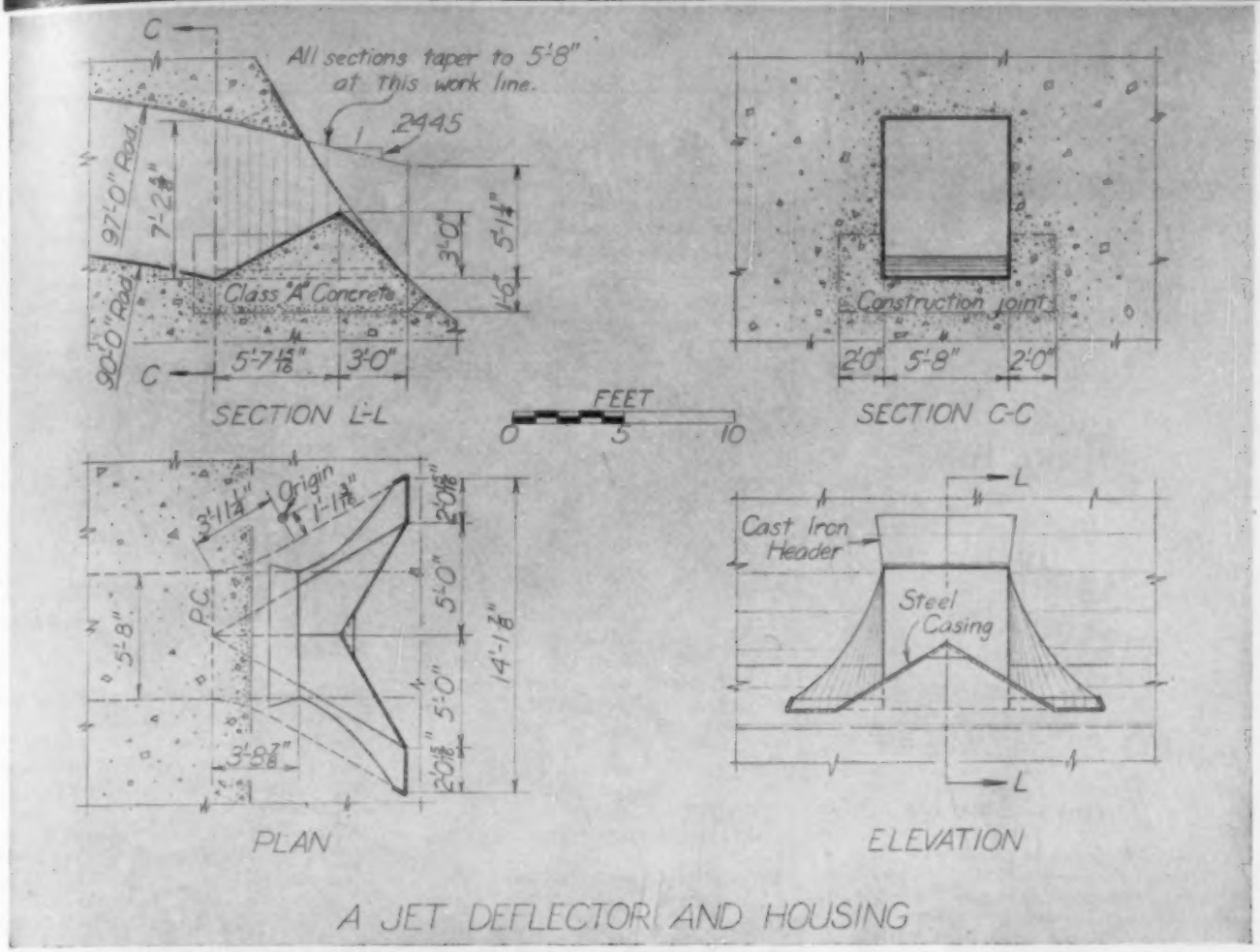
CALIFORNIA. Softening Plant of Metropolitan Water District of Southern California—II, C. P. Hoover, J. M. Montgomery, and W. W. Aultman. *Water Works & Sewerage*, vol. 87, no. 7, July 1940, pp. 293–298. Features of plant design; special carbon handling; flocculators; clarifiers; surface wash for filters; up-flow zeolite units; brine economy. Bibliography.

LOS ANGELES. Boron Creates Special Problems in Los Angeles Water Supply. *Eng. News-Rec.*, vol. 125, no. 3, July 18, 1940, pp. 113–114. Results of study of sources of boron contained in Owens Valley water supply of Los Angeles, Calif., in quantities injurious to growth of citrus trees; reduction of boron content by spreading of irrigation water over natural filtering grounds in which practically all of boron is absorbed before water is delivered to Los Angeles aqueduct.

WATER WORKS ENGINEERING

BETHLEHEM, PA. Mountain Water for Bethlehem. *Eng. News-Rec.*, vol. 125, no. 1, July 4, 1940, pp. 36–38. Description of proposed mountain water supply for Bethlehem, Pa., to cost $3,900,000, involving construction of earth-fill dam (140 ft high), 23 miles of 30- and 36-in. reinforced concrete pipe lines, and 2 miles of tunnel.

*TYPHONITE ELDORADO PENCIL PAGE



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Equipment, Materials, and Methods

New Developments of Interest, as Reported by Manufacturers

"Cat" Diesel Electric

TO ROUND OUT its popular line of Diesel electric sets, Caterpillar Tractor Co. has announced two new models, the 88–41 and the 77–34. Both are powered by four-cylinder Diesel engines. The 88–41 develops 41 kw at 900 rpm, when equipped with radiator fan. Without fan, kilowatt rating is 44. The 77–34 develops 34 kw at the same rpm when equipped with fan. It is rated at 36 kw without fan. Both ratings are for the polyphase, 60-cycle set. Single phase ratings are slightly lower.

The sets are completely self-controlled, requiring no gadgets other than a circuit breaker. They are easy to install, and can be set up and running in less than an hour after delivery. Inbuilt regulation enables the sets to pick up relatively large motor loads with a minimum of light flicker and voltage drop. There are only three operating adjustments on the engines, and none of these involve the fuel system. The generators are direct-connected, rotating field type, available as 3-phase or single-phase, 60-cycle or 50-cycle, and with a wide variety of voltages.

20-Ton Emergency Jack

AN EMERGENCY jack, that has a full 20-ton lifting and holding capacity on either the cap or toe lift, has been announced by Templeton, Kenly & Co., Chicago, Ill.

Designated No. 2030, this jack is 30 in. high, has a full 17¾ in. lift and weighs 167 lb with complete equipment. Besides lifting on cap and toe, it lifts on the auxiliary shoe which hooks into the cap or on the chain with grab hook end, any link of which can be engaged with the recess in the cap. It also tilts on its base for jacking at an angle, and can be used horizontally for pushing, spreading, or pulling by using the chain.

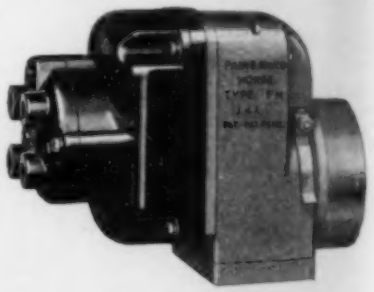
New Rex 10-S Mixer

CHAIN BELT CO., Milwaukee, Wis., announced a new Rex 10-S Mixer, with an air cooled motor, similar to the motors successfully used on Rex 5-S and 7-S Mixers. Besides the new power, with its many well-known advantages, the new Rex 10-S Mixer incorporates all the Rex features: Rex Shimmy Skip, Rex outside pivoted 7 sec discharge, Rex modern drum, Rex positive water system and freeway valve, Rex Timken drum rollers, Rex chain drive and Rex fully enclosed transmission countershaft.

Compact F-M Magnetos

THE DEVELOPMENT of a compact, highly adaptable new series of magnetos, in 1-, 2- and 4-cylinder units, designated as the Type FM-J, is announced by the Magneto Division of Fairbanks, Morse & Co.

The advanced design of the Type FM-J magnetos centers around the powerful die-cast alnico rotor. Due to its great magnetic strength the ignition spark is of full heat and intensity although the size of the unit has been considerably reduced. Simplicity of construction provides sturdiness and dependability in operation, and readily made field adjustments, when necessary.



All magneto units are sealed in dust and moistureproof housings, and are permanently lubricated. The jump-spark distributor of the Type FM-J4 operates in a separate compartment through which air is constantly circulated.

Wide adaptability of application is secured by means of demountable flange and base plates. Both standard and special flanges are available, as well as standard SAE and special design base plates. The basic magneto unit furnished is suitable for 35 mm shaft height base mounting without adapter plates. Impulse couplings and drive members which cover a large number of applications are also available, making the complete Type FM-J magnetos suitable for both original and replacement applications.

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THE QUESTION, "What new product, process, or material might industrial research develop that would be valuable to YOUR industry?" has been put to America's outstanding industrial leaders, by the Liberty Bank of Buffalo, N.Y. A condensed report, based on 1,042 answers, and indicating those items most urgent from the standpoint of National Defense, should be of value to many civil engineers and manufacturers. It covers such industries as: Aeronautics, agricultural equipment, air conditioning and heating, automobiles, building and construction, ceramics, chemicals, electrical equipment, fuel, glass, insecticides and fungicides, instruments, machinery and machine tools, metals, paints and finishes, petroleum, photography, plastics, railroad equipment, and wood. A copy of this report will be sent to manufacturers and engineers writing on their letterheads, so long as the supply lasts.

DO YOU know that an old pump, seemingly faithful, can actually be in conspiracy to keep your power bills high?

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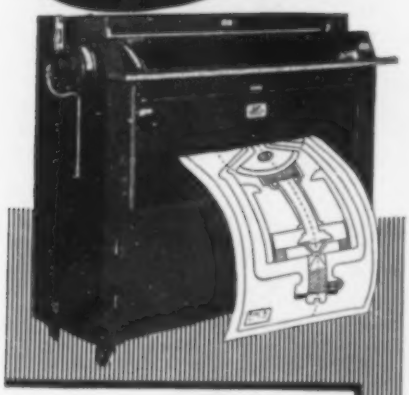

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Truck-Powered Ditching Machine

THE BUCKEYE TRACTION Ditcher Co., Findlay, Ohio, announce the Model 16-S Utility Trenching Machine, which is mounted on and powered by a standard $1^1/_2$-ton truck with dual tandem rear wheels.

The rotary wheel excavator digs to a depth of $5^1/_2$ ft, cutting a clean trench up to 22 in. wide. The spoil can be discharged to either side of the machine. Power from the specially built transmission is delivered to the excavating wheel through the patented constant-center drive which provides for digging speeds up to 10 ft per min. One man at the controls just back of the truck cab can dig from 2,000 to 5,000 lineal ft of trench per day depending on soil conditions. The 16-S, it is claimed, follows any line, straight or curved, digs up and down steep grades and excavates gumbo, hardpan, and impacted gravel. The excavator wheel is hoisted clear of the ground when the truck is being made ready to move to a new location. With the digging wheel in raised position, the overall height is only 11 ft. The Model 16-S is an addition to the line of Buckeye Trenchers designed for every trenching requirement.

Hydraulic Feeder Pump

FOR THOSE situations where electric current or usable rotary power is not available, Proportioneers, Inc., have developed their All-Hydraulic Chlor-O-Feeder.

This feeder is capable of handling hypochlorination in water supplies as large as $1^1/_2$ (or more) million gal per day. At 30 lb pressure of operating water, it may be adjusted from 30 strokes per min down to zero by simple setting of speed control valve. At 60 lb pressure it can operate from 60 strokes per min down to zero, depending on hand setting. As water pressure decreases, the possible top stroking rate decreases. These units have operated on pressures as low as 9 lb per sq in. Waste water consumed by this all-hydraulic machine is low, amounting to only four or five times the daily quantity of reagent fed, so if 10 gal of hypo-chlorite solution per day are fed, waste of water will only be 50 gal per day.

Like all Chlor-O-Feeders, the hydraulic unit is cased in a standard package, which includes everything necessary for a complete installation.

Automotive Diesel

CATERPILLAR TRACTOR Co. has announced a four-cylinder, 60-hp, automotive Diesel engine, called the Model D312.

The engine is a four-stroke, valve-in-head, water-cooled model with a bore of $4^1/_4$ in. and a stroke of $5^1/_2$ in. Maximum horsepower is developed at 1800 rpm, and maximum torque of 193 lb ft at 1200 rpm. Piston displacement is 312 cu in. Pistons are of aluminum alloy. The block, cylinder head and crankcase unit are in cast alloy iron. There are five main crankshaft bearings, with a total surface of 89.5 sq in. Crank pin bearings are $2^3/_4$ in. in diameter and $1^7/_8$ in. in length. There is a crankshaft torsional vibration damper. Water circulation is by pump, with the operating temperature of the water controlled by thermostat. There is an air-cooled type lubricating oil cooler provided. Pressure lubrication is provided to all main and crank pin bearings, camshaft bearings, valve operating mechanism and timing gears.

The engine fuel system is manufactured by Caterpillar Tractor Co., and features solid injection into precombustion chambers. There is an individual pump and valve for each cylinder; and the system is factory set, requiring no adjustment in the field. For replacement installations, "Caterpillar's" Model D312 engine is offered as a complete unit, equipped with a five speed Spice No. 2553 transmission and 13 in. single plate clutch.

Dragline Bucket

THE "BIGLODE," a new streamlined, all-welded dragline bucket for general service, has just been placed on the market by the Harnischfeger Corp. of Milwaukee, Wis.

Special features of the "Biglode" include "balanced" construction for easier handling, simplified design—with arch, body, hitch plates, bucket lip and runners welded into a single unit to provide greater strength, and flared lip-and-teeth assembly to provide digging action similar to a round-nose shovel. The P&H "Biglode" dragline bucket is available with capacities from $^3/_8$ to 4 cu yds.

Pneumatic Wrenches

THREE NEW SIZE reversible wrenches, with bolt size capacity of $^3/_8$ in., $^5/_8$ in., and $^3/_4$ in., respectively, have been developed by Chicago Pneumatic Tool Co., 6 East 44th St., New York, N.Y.

Each of these Power Vane Wrenches employs a slow speed rotary motor which is simple in design, efficient in operation and economical in maintenance. They have no gears or resilient member in the driving unit. Light in weight and short overall length, they are extremely easy to handle.

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500-Amp A-C Arc Welder

THE GENERAL ELECTRIC CO., Schenectady, N.Y., has announced a new line of 500-amp. a-c arc welders with a new electrical design which incorporates power-factor correction.

This built-in feature is reported to make possible a greatly increased power-factor, and to permit the use of smaller-primary cable, line switches and fuses. This is claimed to result in a saving on installation costs and to make possible the addition of more welders to existing feeders without causing overload. Other advantages offered by this new G-E arc welder include finger-tip adjustment by means of an easily turned current-changing crank; a large, easily read current indicator extending up the side of the transformer case; protected output terminals accessible through holes in the insulating panel; and fan-forced ventilation, providing cool, dependable operation even at high currents or high-duty cycles. The new welder is less than 4 ft in height, only 21 in. in diameter, and has a net weight of 600 lbs. The only maintenance required is lubrication of the fan and current-adjuster every 12 to 18 months.

Diesel Driven Compressor

CHICAGO PNEUMATIC TOOL CO., 6 East 44th St., New York, N.Y., have announced a new size of large-capacity Diesel-driven portable compressors—the 500-cu ft Class PO-8. With fuel oil at six cents per gallon, it is claimed that this compressor will operate at full capacity and at 100 lb discharge pressure at a fuel cost of only 41½ cents per hr.

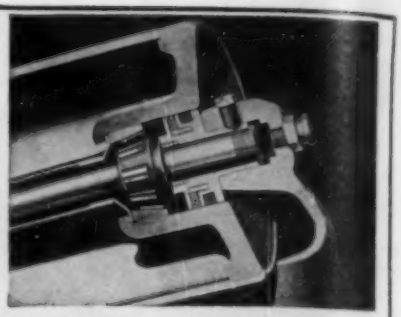
This compressor has two low and two high pressure cylinders located on each side with an included angle of 90 degrees. One low and one high pressure connecting rod operate on each of the four crank pins. The unit has all the dominant features of the smaller CP two-stage compressors, including simplate valves, inlet-valve unloading, pressure lubrication, multiple-disc clutch and sectional intercooler.

A new 28-page bulletin, No. 78, illustrates this Company's entire line of portable compressors of steamlined design.

Large Capacity Pumping Units

FAIRBANKS, MORSE & CO., 600 South Michigan Ave., Chicago, Ill., have announced a new line of Angleflow Pumps for large capacity pumping operations, such as land drainage, flood control, irrigation storm water disposal, municipal pumping, excavation unwatering, coffer dams, dry docks, condenser circulating, etc.

The F-M Angleflow Pump is said to combine the advantages of both the radial flow Francis runner type of centrifugal pump and the axial flow diffuser type of propeller pump, and to be technically a design about half-way between. The hydraulic stream flow through the impeller is at an angle to the axis of rotation (center of pump shaft). This is where the pump gets its name. An Illustrated 16-page bulletin, No. 5710, describes these pumps in both vertical and horizontal types.



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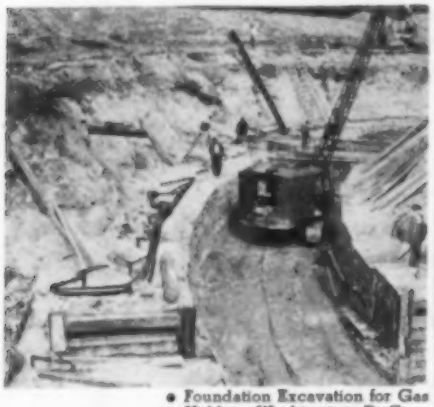

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Literature Available

AIRPORT DRAINAGE—"Building Safety Into Airports—with Efficient Drainage Construction," is the title of a 24-page bulletin again made available by the Armco Drainage Products Assn., Middletown, Ohio. In addition to the bulletin, a preprinted article on "The Nation's No. 1 Modern Airport—LaGuardia Field, New York City," is also available for the asking. Included in the preprint is a layout map of the field and its extensive drainage system. Separate copies of the drainage map on a larger scale are also available.

AIRPORT DRAINAGE—Practical data on the drainage of airports and landing fields is given in a new 32-page bulletin published by Toncan Culvert Mfrs. Assn., Republic Bldg., Cleveland, Ohio. Illustrated with tables, diagrammatic sketches, and actual installation photographs, the bulletin outlines principles and requirements of modern subdrainage systems.

ARC WELDING—"Lessons in Arc Welding," published by The Lincoln Electric Co., Cleveland, Ohio. 144 pages 6 × 9 in; over 100 illustrations, including photographs and drawings; cover—semi-flexible simulated leather, gold embossed. Price is 50 cents per copy, postage prepaid, in U.S.A.

CHEMICAL FEEDERS—Bulletin No. WAT, issued by Proportioneers, Inc., 14 Codding St., Providence, R.I., contains up-to-the-minute information on standardized and accepted methods of hypochlorination, and is replete with information helpful to all engineers and operators interested in chemical treatment of various kinds. All types of Chlor-O-Feeders are described and illustrated by installation photographs.

CHLORINATION—An example of the effective use of break-point chlorination in a municipal water-supply system, with details and cost figures, is given in an illustrated folder. Wallace & Tiernan Co., Inc., Newark, N.J.

CRANES—SHOVELS—Three new 12-page catalogs, recently issued by Bay City Shovels, Inc., Bay City, Mich., cover their low-priced half-yard Model 25, with 5-ton crane rating; their heavy-duty 1¼ yard convertible shovel with 20-ton crane rating; and the truck crane of 16½ and 20-ton lifting capacity, claimed to be the biggest crane on pneumatic tires.

LIQUID LEVEL CONTROL—In sixteen pages, Bulletin 40 describes and illustrates the B/W All-Electric Floatless Liquid Level Controls, Signal and Pump Control, and Motor Starters. Bender Warrick Corp., Birmingham, Mich.

LIQUID LEVEL METERS—A new 8-page bulletin, No. 2990, covering six different styles of mechanical and electric operated liquid level meters, has just been published by Cochrane Corp., Philadelphia, Penna. Types particularly designed for remote service, including float, differential pressure, and bourdon spiral systems, are included, with application drawings and technical data.

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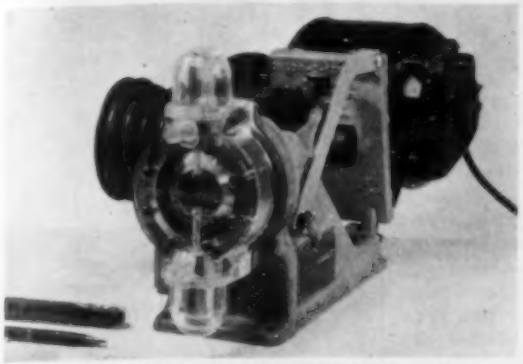

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SEWAGE TREATMENT—Bio-filtration sewage treatment, which is claimed to combine high-rate filtration with recirculation of effluent from sprinkling filters back to detention tanks, and to permit the exact treatment desired by variation of the recirculation ratio, is the subject of new Folder No. 1881, announced by Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

SNOW REMOVAL—Well in advance of actual demands, Caterpillar Tractor Co., Peoria, Ill., announce three bulletins on their snow fighting equipment and the application of "Cat" Diesels to this work.

SWITCH-GEAR—Catalog 1230 describes the Low Voltage Metal-Enclosed Air Circuit Breaker Switch-Gear, and illustrates the feature of withdrawing the breaker from its compartment on telescoping rails. Roller-Smith Co., 1766 W. Market St., Bethlehem, Penna.

TELEMETER—which enables a measurement made at one place to be repeated at a distant point, is described in Bulletin No. 440. The basic principle, the operating characteristics, and some of its uses are covered. The Esterline-Angus Co., Inc., Indianapolis, Ind.

TRUCK CRANE—The wheel mounted crane engineered by The General Excavator Co., Marion, Ohio, is described in word-and-picture stories in a new 12-page bulletin, No. 4018. Working views of the machine in use show typical operations as a crane, clamshell, dragline, pullshovel, and piledrives.

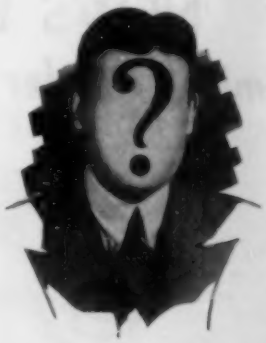
TURBINE PUMPS—Fairbanks-Morse & Co. have issued a revised bulletin, No. 6930, with pictures and details of their water lubricated turbine pumps with open impellers.

VERTICAL PUMP MOTORS—Bullet-type, vertical, hollow-shaft motors, available in squirrel cage, wound rotor or capacitor AC types, also for DC operation, and designed especially for deep well turbine pumps, are covered in a new 8-page Bulletin, No. 3145. Dept. 7N20, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penna.

WATER SOFTENERS—A comprehensive treatise on hot lime soda softening, 32 pages profusely illustrated. Describes the five types of deaerating and non-deaerating heaters, filters both vertical and horizontal, and the electro chemical feed. The Permutit Co., 330 West 42d St., New York, N.Y.

WHEEL SCRAPERS—The new Bucyrus-Erie 4-wheel scrapers are described in a 24-page booklet, which discusses in detail: double-curve cutting edge, balanced weight, positive rolling ejection, controlled depth of speed. Bucyrus-Erie Co., South Milwaukee, Wis.

WIRE ROPE—A folder discussing the advantages of their internally lubricated wire rope as a defense against internal friction and corrosion, entitled, "The Why in Macwhyte Internal Lubrication," is announced by Macwhyte Company, Kenosha, Wis.



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